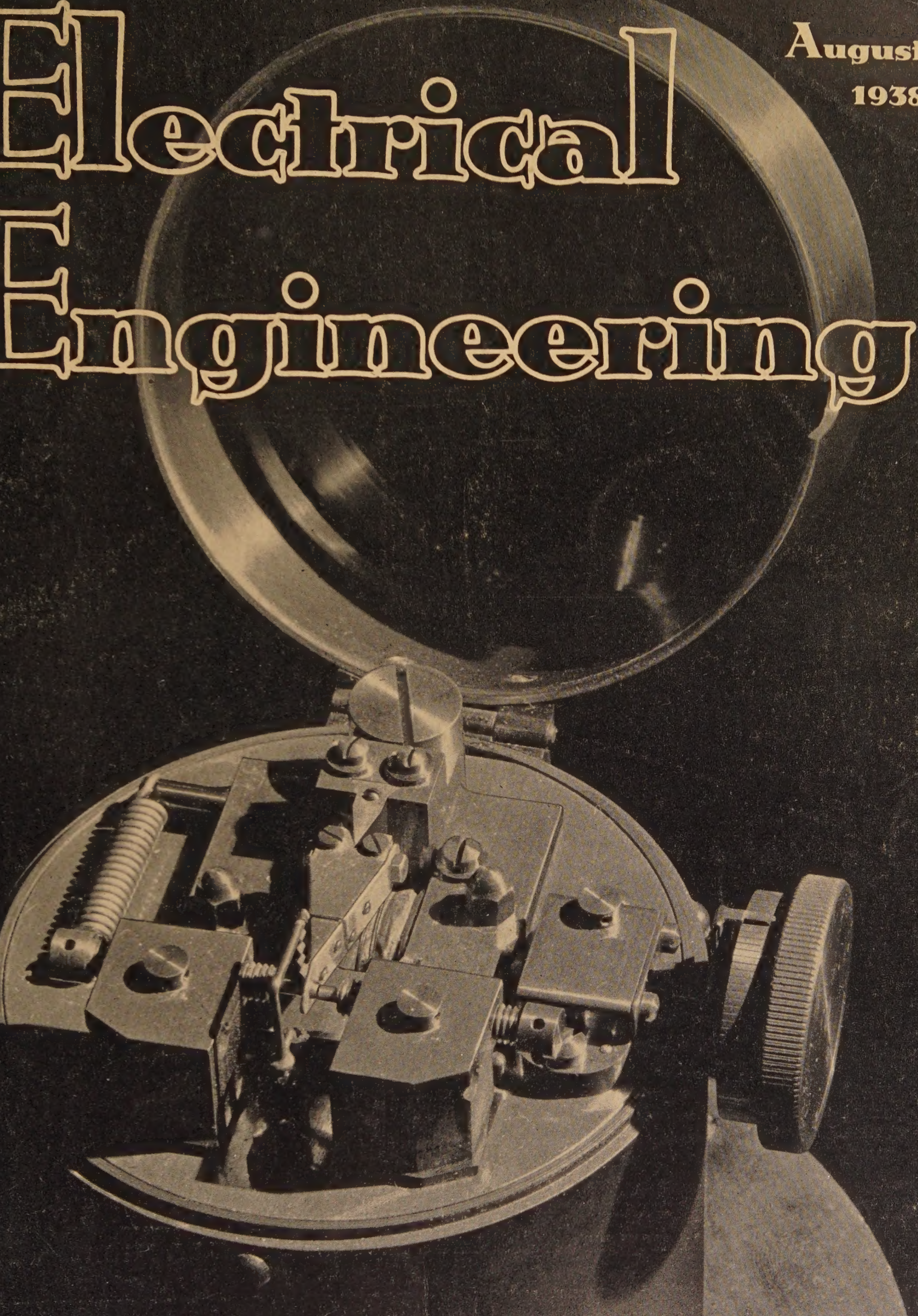
Electrical Engineering

August
1938



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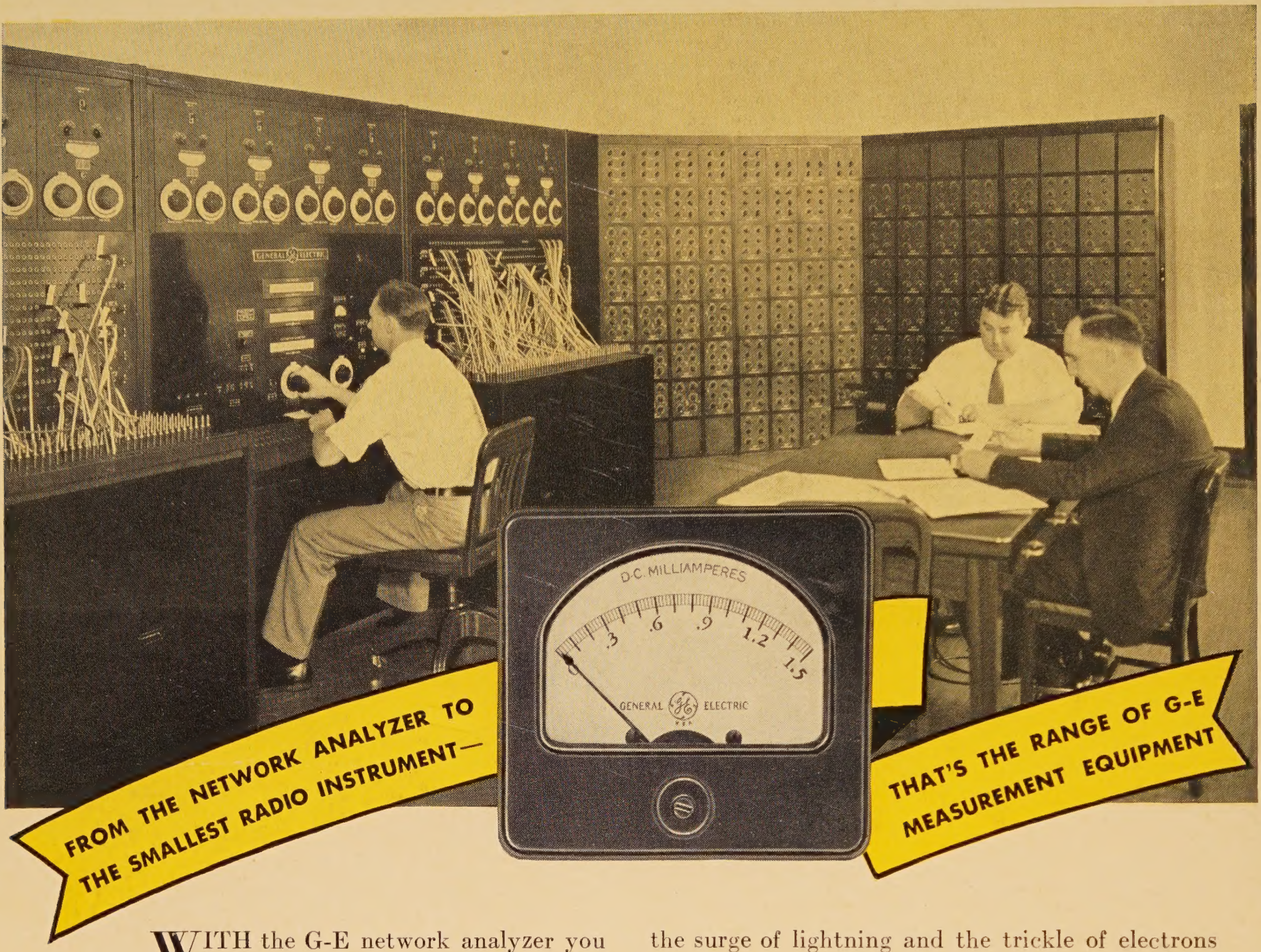
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Electrical Engineering

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for August 1938—

A Message From the President ...John C. Parker ...331

Electrical Precipitation ...W. A. Schmidt and Evald Anderson ...332

The Engineer and Trends in Economic Thought ...Frank B. Jewett ...339

Rural Electrification in England ...345

News of Institute and Related Activities (See next page) ...349

*Transactions Section—Papers and Correlated Discussions** *(Follows EE Page 366)*

Subharmonics in Circuits Containing Iron-Cored Reactors ...Irven Travis and C. N. Weygandt ...423

Recovery Voltages and Protector-Tube Application ...R. D. Evans and A. C. Monteith ...432

Critical Conditions in Ferroresonance ...P. H. Odessey and Ernst Weber ...444

Overvoltages Caused by Unbalanced Short Circuits ...Edith Clarke, C. N. Weygandt and C. Concordia ...453

Resonant Nonlinear Control Circuits ...William T. Thomson ...469

*For discussions of previously published papers, see next page.

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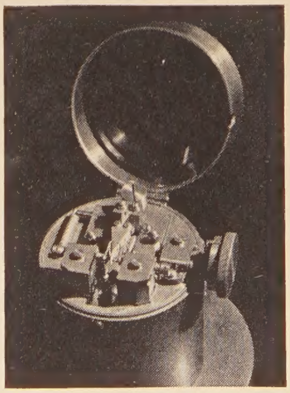
The Cover

A telegraph relay for high-speed submarine cables, enlarged to approximately double diameter

Bell Tel. Labs. photo



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High Lights

Subharmonic Currents. Circuits containing iron-cored inductors, which become saturated so that their reactances do not remain constant, may carry current having a frequency different from that of the applied voltage—in other words, a "subharmonic" current. Recent use of series capacitors to offset inductive voltage-drop in power-transmission systems has increased the importance of subharmonic oscillations in engineering practice. A simplified mathematical analysis reveals something of the nature and occurrence of such oscillations (*Transactions pages 423–31*).

Ferroresonant Circuits. The "ferroresonant" type of nonlinear circuit containing a resistor, a capacitor, and a saturable-core reactor has been applied to several engineering problems in control. Two papers in this issue describe the characteristics and applications of circuits of this type: One (*Transactions pages 469–76*) describes a sensitive and stable power-controlling device; the other defines some of the critical factors affecting stability in such nonlinear circuits (*Transactions pages 444–52*).

System Recovery Voltage. If an arc-interrupting device is to operate successfully, the insulation recovery-voltage characteristic of the device should be higher than that of the system. Consequently, a sound application of protector tubes requires a broad knowledge of the characteristics of power transmission systems. A survey of the recovery-voltage characteristics of typical systems has been conducted, and the results are presented in this issue (*Transactions pages 432–43*).

Overvoltages Caused by Short Circuits. During an unbalanced fault on a power system a high voltage may develop across the unfaulted phase or phases. Overvoltage may be caused by the short circuit itself, and a further overvoltage by the clearing of the fault. Some such excessive voltages may be reduced or suppressed completely by the use of amortisseur windings on the synchronous machines supplying the fault current (*Transactions pages 453–68*).

Electrical Precipitation, as a means of removing dust particles from air, is a familiar process. Less well known are the equally spectacular applications of the method in industry, such as the reclamation of valuable materials from waste gases or the purification of gases for subsequent use. The evolution and application of electrical precipitation are reviewed in this issue (*pages 332–8*).

Pamphlet Papers Available. Response to the offer and order form published in the July issue was heavy, and some additional papers now are out of stock. However, a limited stock of some 70-odd papers prepared in pamphlet form for use at the winter convention, the North Eastern District meeting, and the summer convention still is available (*page 366*).

Engineers and Economics. The engineer in his relation to current economic trends provides a fertile field of political and sociological speculation. An eminent leader in research and past president of the Institute has analyzed some of these trends in economic philosophy, and has attempted to clarify the position of the engineer (*pages 339–44*).

Rural Electrification. In England some of the problems differ from those prevailing in the United States. Such differences are pointed out, and a typical British rural electric system is described (*pages 345–8*).

Summer Convention. Supplementing the initial reports published in the July issue, a full report covering the activities of the recent summer convention in Washington, D.C. may be found in this issue (*pages 349–51*).

News 349

AIEE Summer Convention 349
Annual Conference of Officers, Delegates, Members 351
AIEE Directors Meet During Summer Convention . . 354
Reports of Five Technical Conferences 355
Lightning Arrester Subcommittee Meets 357
Detroit-Ann Arbor Section Becomes Michigan Section 357
Southern District to Meet at Miami, Fla. 357

Future AIEE Meetings 351
Future Meetings of Other Societies 358
Letters to the Editor 358
Usefulness of Mathematics in Engineering 358
Journals for Electrical Engineers 359
What Is Tensor Analysis? 360
Electronic Switching Circuits 360

Personal Items 359
Membership 364
Engineering Literature 365
Pamphlet Copies of Papers Available 366
Industrial Notes . . . . (See advertising section)
New Products . . . . (See advertising section)
Employment Notes . . . . (See advertising section)
Officers and Committees . . . (For complete listing see forthcoming September 1938 issue)

Coming Soon. Among special articles and technical papers now undergoing preparation for early publication in Electrical Engineering are: an article describing the electrification of the San Francisco Bay Bridge for railway operation, by Paul Lebenbaum (M'13); a summer convention address "Progress in Weather Forecasting," by W. R. Gregg, chief of the Weather Bureau; a description of the new transcontinental telephone lines by J. J. Pilliod (F'34); four technical papers concerning distribution system voltage regulation—one on planning and operation by T. J. Brosnan (M'34), one on the characteristics of regulating equipment by P. E. Benner (A'28) and G. S. Lunge (A'23), one discussing the problems of a rural distribution system by G. H. Landis (M'33), and one pertaining to periodic voltage surveys by R. W. Burrell (A'35) and W. E. Appleton (A'35); four papers descriptive of industrial applications of new electrical equipment—a description of regenerative tension control for winders in paper mills by H. W. Rogers (A'12), a comparison of methods of stopping squirrel-cage induction motors by W. I. Bendz, suggestions for the use of capacitors for power-factor correction in industrial plants by C. E. H. von Sothen, and a description of a photoelectric weft-straightener control for textile mills by C. W. LaPierre (A'28) and A. P. Mansfield; two papers pertaining to power transformers—data on corona voltages of typical insulating materials under oil by F. J. Vogel (A'21), and a paper describing d-c transformers by T. C. Lennox (A'23) and E. V. De Blieux (A'34); a paper giving further data concerning multiple lightning strokes, by K. B. McEachron (F'37); and a paper reporting further experience data concerning protector-tube application and performance on 132-kv transmission lines, by Philip Sporn (F'30) and I. W. Gross (A'12).

DISCUSSIONS

Appearing in this issue are discussions of the following previously published papers:

Basic Sciences

Matrices in Engineering—Pipes 477
The Properties of Three-Phase Systems Deduced With the Aid of Matrices—Reed 477

Cables

Oil Oxidation in Impregnated Paper—Whitehead and Jones 482
The Current-Carrying Capacity of Rubber-Insulated Conductors—Rosch 484
Mechanical Uniformity of Paper-Insulated Cables—Wyatt, Smart, and Reynar 486

Electrical Machinery

Corona Voltages of Typical Transformer Insulations Under Oil—Vogel 478
A Formula for the Reactance of the Interleaved Component of Transformers—Dwight and Dzung 480

Statements and opinions given in articles and papers appearing in Electrical Engineering are the expressions of contributors, for which the Institute assumes no responsibility. Correspondence is invited on all controversial matters. ¶ Subscriptions—$12 per year to United States, Mexico, Cuba, Porto Rico, Hawaii, Philippine Islands, Central and South America, Haiti, Spain, Spanish Colonies; $13 to Canada; $14 elsewhere. Single copy $1.50. ¶ Address changes must be received by the fifteenth of the month to be effective with the succeeding issue. Copies undelivered because of incorrect address cannot be replaced without charge. ¶ Electrical Engineering is indexed annually by the Institute, weekly and monthly by *Engineering Index*, and monthly by *Industrial Arts Index*; abstracted monthly by *Science Abstracts* (London). ¶ Copyright 1938 by the American Institute of Electrical Engineers. Number of copies this issue —20,700.

A Message From the President

IN THIS, my first official expression to the membership of the Institute as a whole, I think I cannot do better than to say again what I said at the annual meeting in Washington when Doctor Harrison formally announced the election of his successor.

To acknowledge the receipt from our distinguished Institute of a great honor would, in the present instance, be impossible since such acknowledgment would presuppose some measure of desert.

One would have to be a very great engineer, indeed, worthily to stand in the place of those heroic figures who have made our branch of the profession what it is. If we keep alive and undimmed the light which they have kindled, we shall do well indeed. Yet, in a sense, we may, in all humility, find membership in the Institute in any of its grades, service in any of its offices, or a place on any of its committees a high measure of distinction in that we have received recognition of our spiritual kinship with and devotion to those who have made the Institute and the profession something infinitely finer and greater than any one of us alone can be.

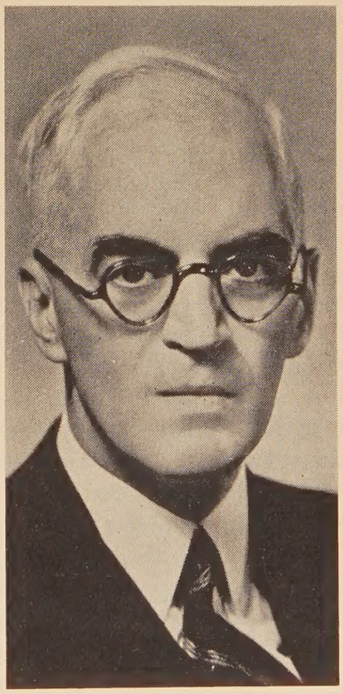
Here, because of the quality that was in the founders, and perhaps, too, because of those things in electrical engineering which attracted them to it when it was only a vision and a promise, we find a field in which we exercise the utmost that is in us, whether of intellectual power or of those finer qualities of the spirit which are the source of a genuine professional attitude.

It is no accident but rather the very essence of our calling that in the Institute fact transcends mere opinion; that where the limitations of precise knowledge require the exercise of judgment opinions can be vigorously advanced without rancor; that the history of the Institute is remarkably free from politics and strife on the one hand and from suppression or coercion of expression on the other. This heritage is handed on to us as a vital thing. We will pay devotion to the founders and honor ourselves in keeping it alive, adapting our specific processes to the changing requirements of each new day while holding fast to that fundamental zeal for truth and for selfless devotion to making truth serve the needs of mankind which characterized our predecessors.

No one could have attended the Washington convention or have heard the reports of Section activities there presented without being impressed by the fact that the fine fraternity of aspiration and idealism which is in the membership assures for our calling, as represented in the Institute, a future worthy of its past.

Engineers are idealists, in all that the word implies of vision and faith and courage, but the idealism of the engineer is not a nebulous thing, remote from reality. So it comes about that the Institute finds most realistic expression for its finest aspirations in the day-by-day conduct of its affairs. The Sections are strong and stand on their own feet. The excellent staff at headquarters, the board and the officers of the Institute belong to the membership and serve the Institute as the members direct. This is no organization built from a center out. On the contrary your officers can give the highest expression to the purposes of the Institute only as the members either personally or through their Section representatives guide and advise, and above all else as each member actively participates in the conduct of his Section meetings.

Our best expression of our professional attitude would be feeble if it did not reflect itself in so humdrum a thing as a growing membership and a strong financial status. Thanks to the careful and devoted work of the Sections, the membership committee, the finance committee, the treasurer, the headquarters office and my predecessors in the presidency of the Institute, the membership is strong, and, as shown by the treasurer's report, the financial condition of the Institute is sound. The year ahead may offer difficult problems in these matters, but, if the long-continuing conduct of the Institute carries any prophecy for the future, these problems, while difficult, will not be hopeless of solution.



I have faith that all of us in co-operation cannot only maintain the membership and the splendid financial condition of the Institute, the excellent character of its publications and the high type of papers presented at its meetings but even somewhat extend the usefulness of the organization to the membership. To this end the administrative officers look to the membership to make known their desires for the progress of their association.

John C Parker

Electrical Precipitation

By WALTER A. SCHMIDT
MEMBER AIEE

EVALD ANDERSON
NONMEMBER AIEE

Probably the most familiar use of electrical precipitation is in the removal of dust particles from air. Nevertheless, the method has a variety of other useful applications in industry, such as the recovery of valuable materials from waste gases, or the cleaning and preparation of gases for subsequent use. The evolution and application of electrical precipitation are reviewed briefly here.

AS EARLY as 1771, G. Beccaria recorded observations on electrical discharges through smoke-filled gases[1] but the experiments of Hohlfeld, in Germany, about 1824, and Guitard, in France, about 1850, who each independently discussed the electrical precipitation effect on suspended matter in gases, are better known. Hohlfeld[2] electrified points in a jar filled with fog and saw the fog particles precipitate on the side of the jar and disappear, and Guitard[3] made similar observations on tobacco smoke.

These early experiments were largely a part of the investigation of general electrical phenomena. About 1880, however, Oliver Lodge in England became interested and investigated different means for cleaning fume-laden gases. Starting with Lord Rayleigh's experiments on the cleaning action of a temperature gradient about a heated metal rod in a dirty gas, and then turning to electrical action he rediscovered the Hohlfeld and Guitard effect. Lodge[4,5] (later Sir Oliver Lodge), however, carried the experiments further and with Walker developed and built the first electrical precipitator at the Dee Bank Lead Works.

The precipitator was not a success, however, partly because the fume chosen was one of the most difficult to precipitate, and partly because the only high-potential source of electrical energy available was the electrostatic generator, which had only a small current capacity. Had he chanced to make his first trial on conducting particles like sulphuric acid mist as later did Cottrell, the story might well have been different. To Sir Oliver Lodge, therefore, should go the credit for having been the first to discover independently electrical precipitation in the laboratory and carry it forward to industrial application.

In Germany, Moeller's "electrofilter," patented in 1884, apparently was never used, and after the unsuccessful attempt of Oliver Lodge to precipitate lead fume, little, if anything, was done in this field for many years. About 1900, Exum P. Lewis, professor of physics at the University of California, whose discovery of the so-called "afterglow" in nitrogen and other electrical effects in gases attest his interest in this field, inaugurated a course in electrical discharge through gases, where one of his lecture demonstrations was a repetition of the Hohlfeld experiment. Among his colleagues and students were Frederick Gardner Cottrell, professor of physical chemistry at the same university, and J. G. Davidson, later professor of physics at the University of British Columbia. One of Doctor Davidson's research problems under Professor Lewis was the motion and precipitation of ions and charged particles in an electric field, where the primary charging action took place in a stage separate from the precipitating action.

Professor Cottrell had become interested in the precipitation of sulphuric-acid mist, which was becoming a serious problem in some industries. After experimenting with centrifugal methods, he turned to the principle described by Hohlfeld and just then being investigated by Professor Lewis and his students. Professor Cottrell realized that a better source of high potential electrical energy was necessary, and adopted the mechanical rectifier and a-c transformer to provide the required high-potential unidirectional impulses. He also recognized that the simplest and nearly always the most effective method was to charge and precipitate the particles in a single stage by the same field and in the same space. He used this principle in the first commercial and really practical electrical precipitator, which he built at Selby, to precipitate sulphuric-acid mist, and which, incidentally, still operates. The two-stage method, in which the particles are charged and precipitated in separate fields or stages, proved less generally applicable, even though it has certain advantages in specific instances.

Professor Cottrell's next commercial precipitator was one for the collection of zinc and lead fume. But despite his fairly adequate electrical equipment, this problem again baffled the investigator, as it had Sir Oliver Lodge many years earlier. The theory of electrical precipitation deals not only with simple electronic carriers in metals and gases or fairly simple ions in liquids, or with electromagnetic effects in space, all of which may be analyzed theoretically. It deals also with charged material particles in gases (as differentiated from electrons and liquid ions), whose behavior is so greatly affected by their environment and immediate previous history that their behavior is far less easily predicted. Lead and zinc fume are extreme examples of these unpredictable electricity carriers, and it was not until many years after Cottrell's experiments that Wolcott[6] discovered the reason for the failure of both

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Written especially for ELECTRICAL ENGINEERING. WALTER A. SCHMIDT is president and general manager of the Western Precipitation Corporation, Los Angeles, Calif., and EVALD ANDERSON is technical director of the Western Precipitation Corporation and consulting engineer for the Research Corporation. Mr. Schmidt studied chemistry at the University of California, receiving the degree of bachelor of science there in 1906. Following his graduation he held various positions until he became an engineer for the Western Precipitation Corporation in 1909. He became general manager in 1911. Mr. Anderson, a native of Sweden, also studied chemistry at the University of California and received the degree of bachelor of science in 1913. He has been successively physical chemist, research engineer, and technical director of the Western Precipitation Corporation.

[1] For all numbered references, see list at end of article.

Lodge's and Cottrell's lead- and zinc-fume precipitators. Because of the complex nature of its electric carriers, electrical precipitation belongs really more to applied physics than to electrical engineering.

Walter A. Schmidt, one of Professor Cottrell's students, undertook to apply the process to the precipitation of cement-kiln dust at temperatures often exceeding 500 degrees centigrade.[7] Here neither the pubescent electrode previously used in cold gases, nor the serrated mica electrode used with acid mist, was practical. Out of this work came the edge-and-fine-wire discharge electrode, perhaps the greatest improvement in the art since Cottrell's pioneering work.[8]

While the general superiority of Cottrell's single-stage precipitator still was acknowledged these early investigators were fully aware of the special usefulness of two-stage precharging precipitators. Thus Schmidt patented the so-called "follow up treater," which patent discloses practically every kind of two-stage precipitator so far tried in practice, as well as many more not yet tried.

The need by industry for the process was so great that there was hardly ever an opportunity for the ordinary development program. Large $100,000 precipitators had to be designed and built with no more than laboratory tests as guides, but so secure was the foundation on which they were based that there were very few failures. Since then, the organizations that have continued the process both in the United States and in Europe have carried on continuous research and development work, but frequently their engineers find their "new" discoveries fully described in papers by those early investigators.

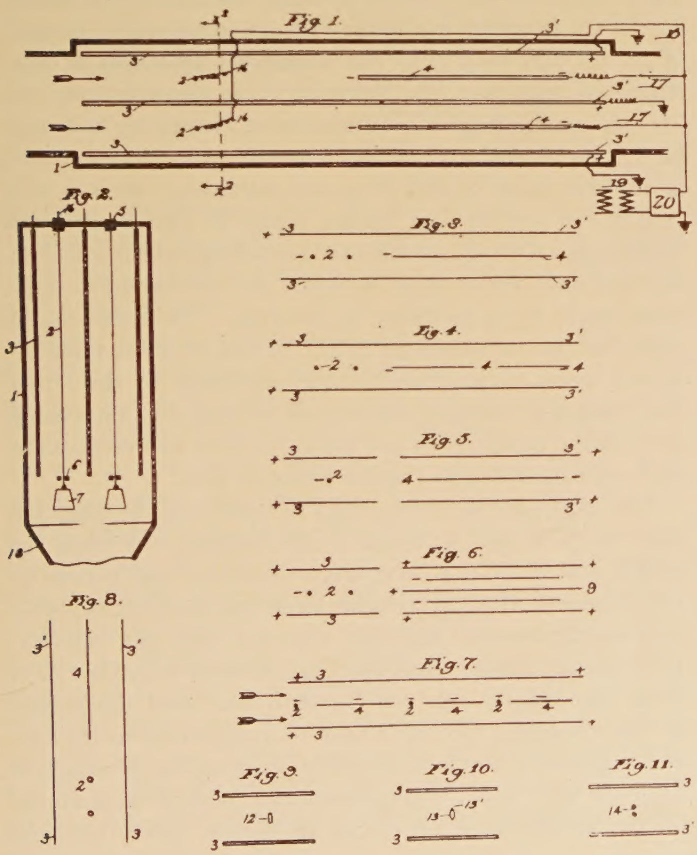


Figure 1. Diagram of a two-stage precipitator, taken from a patent drawing

Figures 1 and 2 (of this figure) show plan and elevation, respectively, of horizontal plate precipitator with ionizing or charging electrodes (2) in the first stage and precipitating electrodes (4) in the second stage

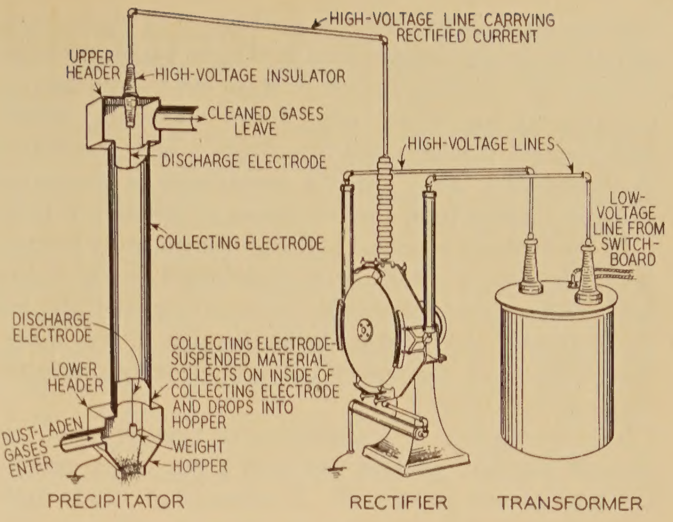


Figure 2. Diagrammatic representation of a Cottrell precipitator

This is a "single-stage pipe precipitator" with a "discharge electrode" serving both as charging and precipitating electrode; shown energized from transformer-mechanical-rectifier power unit

General Principles

In order to remove suspended particles from a gas by the electrical precipitation process the following steps are necessary:

1. Charging the particles by means of gaseous ions or electrons.
2. Precipitating or transporting the charged particles through the gas to the collecting electrode by the force exerted on the charged particles by the electric field.
3. Discharging the charged particles.
4. Removing the precipitated material from the electrode, to a suitable receptacle.

The ions or electrons required to charge the particles may be obtained in different ways, as from flames, radioactive disintegration, or friction, but the only important practical source is the corona discharge in a gas, and ordinarily the discharge is maintained in the gas carrying the suspended matter. The rate and extent of the charging processes by ions of this type have been investigated extensively,[9,10] although there is still much to learn about them.

Both the maximum charge and the rate of charging depend on the size of the particle, the ion concentration, and the strength of the electric field, and, as the speed of a charged particle in the electric field depends on its charge, precipitation engineers strive to secure the maximum number of ions on every particle.

In the so-called precharging or two-stage type of precipitator, one section or stage has a corona field in which sufficient gaseous ionization is maintained to charge completely the suspended particles in the gas passing through it, while the following section or stage has nondischarging precipitating electrodes only, where maximum electric field strength is maintained to produce a high translation or precipitation rate. Such a precipitator is illustrated in figure 1, taken from a patent issued to Schmidt in 1920.

In the ordinary so-called ionizing or single-stage precipitator, the corona discharge is maintained in the entire field. This makes for simpler construction, and also for high-intensity precipitating fields, because of the space-charge effect. A diagram of such a single-stage precipitator is shown in figure 2.

This second step of precipitation or translation of the charged particles perhaps has been given undue prominence by almost all writers. It seems simple, lends itself to mathematical treatment better than the other equally important steps in the process, and the average reader can get the impression from some published accounts of electrical precipitation theory that this step is the essential feature. In calculating this rate of precipitation, one ordinarily determines or assumes the number of charges on a particle of a given size and calculates its speed in the electric field between the electrodes of the precipitator, assuming Stokes' law for the motion of spherical particles in still gas. The electric field may be either the simple electrostatic field in a precharging or two-stage precipitator, or the more complicated space-charge field in the single-stage precipitator. Such calculations give velocities of from 1 to 60 centimeters per second for particles of from 0.1 to ten microns in ordinary precipitation fields, but the uncertainty of the assumptions makes these values equally uncertain.[9] Actually the precipitation, or translation rate, may be of minor importance in considering the real problem of separating ordinary uncharged suspended particles from the gas and delivering them into a dust hopper or receptacle.

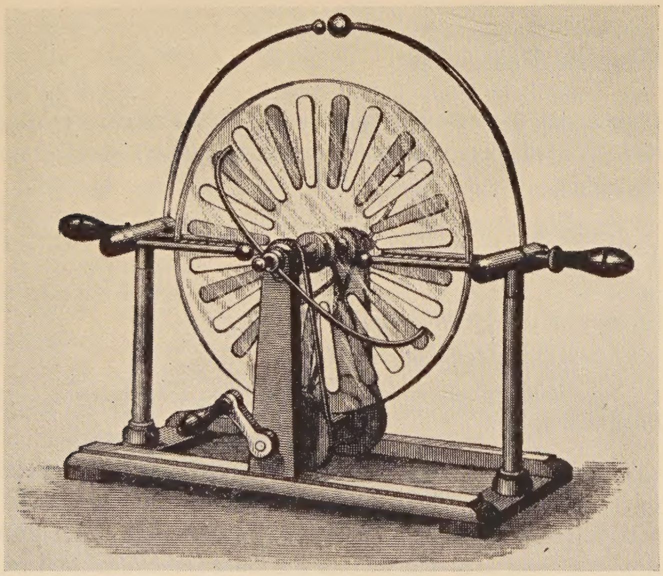


Figure 3. Electrostatic generator as used by Lodge

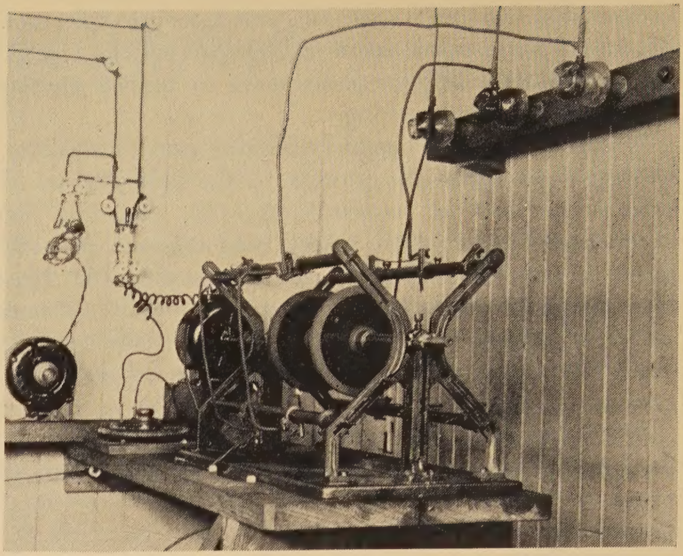


Figure 4. Cottrell's early laboratory rectifier

The third step in the process, that of discharging the charged particles at the collecting electrode, often is the one which actually determines the rate of precipitation. If the electric charges cannot be delivered to the collecting electrode as the charged particles are transported there by the electric field, a counter field, or "dust space charge" is set up and may stop the whole precipitation action. Although particles are referred to as "conducting" or "poorly conducting" the conductance frequently is a surface phenomenon, and usually depends on the conductance of the gas layer occluded on the particles. It was this step in the process that baffled Lodge at Dee Bank Lead Works, and Cottrell, in his first metallurgical installation, and not until the work of Wolcott[6] did precipitation engineers begin to understand the trouble. Occluded water vapor on the surface of a particle probably is the most effective agent in promoting rapid discharge of the "dust ion," and it is common experience to find that increasing the relative humidity of the gas by as little as five per cent may more than double the precipitation rate.

The fourth and last step, that of removing the collected material from the electrodes to the hopper, may seem too simple and obvious to warrant discussion; but precipitation engineers always strive for large gas-handling capacity in small apparatus, and this calls for high gas velocity. It is therefore always possible that the materials that have been successfully charged, precipitated, and discharged on the collecting electrode may be redispersed in the gas. For this reason much of the effort of precipitation research has been used in developing means for holding the material on the electrodes until it can be moved safely into the hopper.

Chemical Activity in Electrical Precipitators

Although the main effects in the electrical precipitation process, that is, separating suspended matter from a gas,

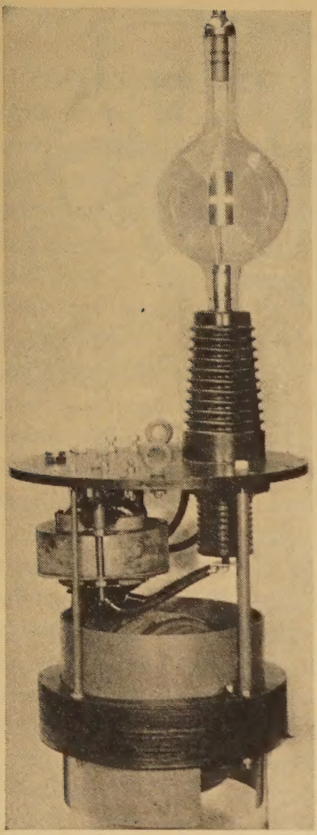


Figure 5. Cottrell transformer, with case removed, and its associated electron-tube rectifier

may belong in the domain of physics, the process is made possible by gaseous ionization, which, if not a chemical process, is at least closely associated with chemical change. Thus, the recombination of gaseous ions may in itself be a step in a chemical process, and the light emission accompanying the corona discharge may serve also to activate chemical changes. This chemical activity associated with the corona or silent discharge has interested investigators for some time. In 1879 Berthelot[11] discussed his own and earlier work on the effect of such discharges in a number of different gases, and more recently Lind[12] summarized the various theories that have been advanced for explaining this effect. Such chemical activity therefore must be associated with electrical precipitation in almost all gases. The proportion of the total electrical energy used for ionization actually transformed into chemical energy is so small, however, that unless the new compounds that are formed have some striking characteristics it is often difficult to prove their existence.

When the corona discharge takes place in air, compounds of oxygen and nitrogen are formed; oxygen molecules and atoms combine to form ozone, and nitrogen combines with oxygen to form nitrogen oxides. However, the ozone formation predominates, and partly for this reason and partly because this reaction is important commercially it has received the most attention. One of the earliest investigators in this field was Warburg,[13] in Germany, who published accounts of his work on ozone formation in the corona discharge as early as 1902. In the United States, Anderegg[14] and co-workers investigated the ozone formation in pipe "precipitators." In the early twenties Anderson investigated ozone formation in a precipitator used for purifying the ventilating air in an office building, and later Mierdel, in Germany, carried out an extensive series of experiments with a great number of different electrode arrangements.

It thus was established early that the amount of ozone formed is proportional to the corona current, is a function of the area of the electrode surface, and that no ozone forms in an ion-free electrostatic field where there is no corona. Investigators that were interested in increasing the ozone production of the so-called ozonizers discovered, for example, that increasing the frequency of the electric current accelerates the reaction, but that water vapor retards it.

The precipitation engineer thus has had the necessary data on ozone formation in precipitators treating air or oxygen, but has not been so fortunate in having data on what to do with the ozone. One school of physiologists and air-conditioning engineers has maintained, and still does maintain, that small amounts of ozone are highly beneficial and make ordinary air similar to the invigorating air in the mountains, or to the air after a thunderstorm on a muggy day. Another school has maintained that ozone is one of the most poisonous of gases, being in the same class as arsene and hydrocyanic gas. A like controversy also goes on regarding the physiological effect of ions in air.

Over 20 years' experience with, and exposure to large concentrations of ozone in closed laboratories forces the authors to conclude that either they and their co-workers are abnormally tough and ozone-resistant individuals, or some of the data on the toxicity of ozone are slightly exaggerated.

Recent data on the use of ozone in refrigerated storage[15] indicate that ozone in concentrations of less than one part per million has no harmful or disagreeable effects on the men exposed to it during working hours. Nevertheless, there seems to be no conclusive proof of the highly beneficial effects claimed by some of the manufacturers of ozonizers, even though Plank, of Karlsruhe, in a recent article reported that certain strains of molds and bacteria become "ozone acclimatized," and then grow faster in ozone-rich air than in ordinary air. This confusion of thought is strikingly exemplified today in some of the larger cities, where manufacturers stress the grave danger of even minute quantities of ozone in ventilating air, while others promote the sale of ozonizers for getting large quantities of ozone into this same kind of air.

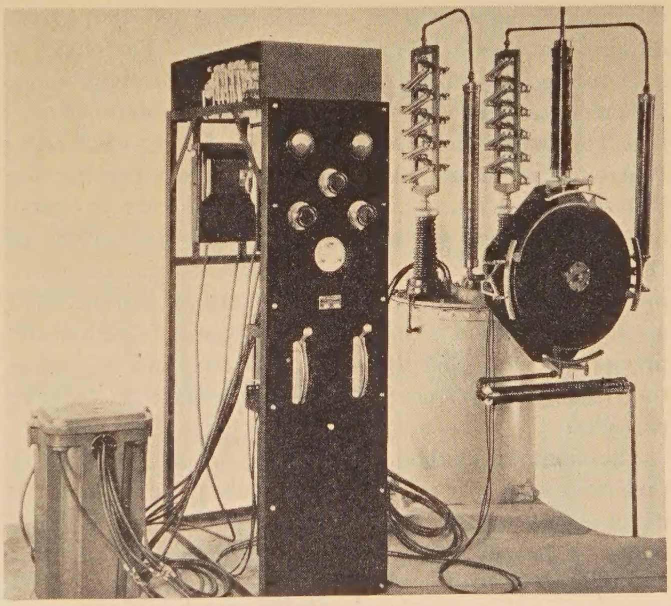
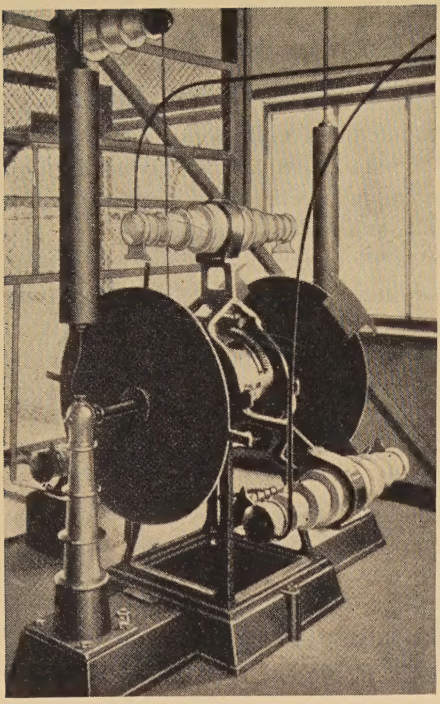


Figure 6. Standard transformer-rectifier set



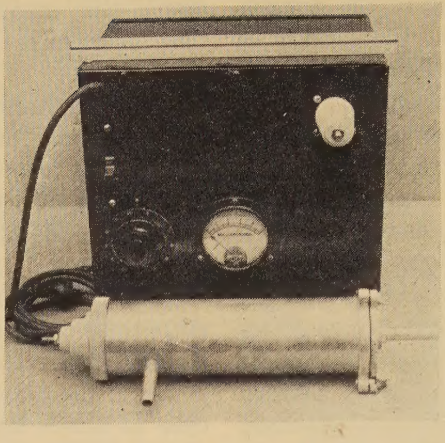


Figure 8 (middle). A typical small electrofilter used for sampling

Figure 7 (left). A three-phase mechanical rectifier

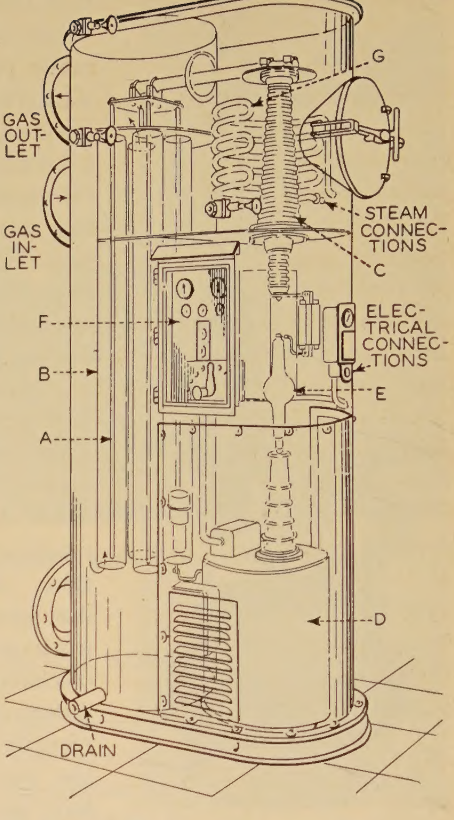


Figure 9 (right). A small single-stage four-pipe precipitator

A—Charging and precipitating electrodes
B—Receiving or collecting electrodes
C—Insulator and bushing supporting receiving and collecting electrodes
D—Transformer
E—Half-wave electron-tube rectifier
F—Control board
G—Steam coil for heating insulator compartment, to prevent condensation

A certain amount of corona current is necessary to charge the dust particles in electrical precipitation, but the electric field for precipitating these particles can be established either with the ion-free electrostatic field of the nonionizing electrodes or with the space-charge-conditioned field of the ionizing electrodes. Therefore, if large amounts of ozone are required, a single-stage ionizing precipitator is used with the maximum amount of current, or with dielectric-covered discharge electrodes. Where minimum ozone is desired, a two-stage precipitator is employed with the ionizing electrode in the first or charging stage, of such size as to give just enough current to charge the particles, and of such type as to give the minimum amount of ozone per unit of charging current. An alternative method is the use of a single-stage electrostatic precipitator with such discharge electrodes and voltage as to give only enough corona for charging the dust or other particles.

The common method of recording ozone formation in precipitators is as concentration in parts per million. This is not a very satisfactory method, however, since it really is only a measure of dilution. A more exact measure is the amount of ozone formed per unit of current. Here, too, because the reaction of ozone formation is a reversible one, the net rate of ozone formation decreases from a maximum value at the beginning, when no ozone is present, to zero in a closed vessel, in which the maximum concentration has been reached at equilibrium. At low concentration, such as used in ordinary electrical-precipitation practice, where large volumes of air are passed by the ionizing electrodes, the ozone formation may vary from 0.1 to 10.0 milligrams per minute per milliampere (equivalent to mols per coulomb). The resulting ozone concentration then may vary from 20,000 parts per million at near equilibrium in a closed vessel, to one part in 400 millions or more in a properly designed precipitator.

Electrical Equipment

The electrical engineer probably is interested chiefly in the electrical machinery used for producing the high-potential electricity in the process. As already mentioned, one of Cottrell's important contributions was his adaptation of the mechanical rectifier and high-voltage transformer for electrical precipitation.

The combination of mechanical rectifier and transformer still is the most common source of power for precipitators. However, other means of rectification, such as the hot-cathode electron-tube rectifier, have been used for many years, and high-voltage a-c generators, such as the Girvin generator also have been tried. But the all-important factor in precipitation still is the nature of the particles in the gas, and almost any source of high-potential unidirectional electrical impulses that produce ions and high-intensity electrical fields serve equally well; so that first cost and operating expense, rather than wave form and other electrical characteristics, have been the primary consideration.

In figures 3, 4, 5, 6, and 7 are shown pictures of some of the electrical equipment used in the process, from Cottrell's early laboratory rectifier and Lodge's electrostatic generator to the electron-tube and mechanical-rectifier equipment of today.

Types of Precipitators

The essential parts of any electrical precipitator or electrofilter, are an ionizing electrode, with its opposing "receiving" electrode, for producing the gas ions and electric fields necessary for the rapid charging of the suspended particles; and the precipitating electrode for producing the electric field necessary to transport the charged particles and to hold them on the collecting electrode until they can be removed to the hopper or receptacle. In the so-called precharging or two-stage precipitator, these parts are separated so as to give an ionizing or charging section and a precipitating or collecting section. In the more common so-called ionizing or single-stage precipitator the fields are combined, and the single set of high-voltage electrodes serve both for charging and for precipitating.

A great many different types of precipitators have been described and used. These differ chiefly in the details of the receiving or collecting electrodes, which may be cylinders or pipes, plain or corrugated plates, special pocket plates or screens and rod curtains. In the last type the gas may pass either parallel to the receiving and collecting electrodes or through them.

Precipitator units vary in size even more than in type. The size ranges from the small gas-sampling electrofilter, handling one or two cubic feet of gas per minute to the large rod-curtain unit for cement-mill or smelter gases, with a capacity of 100,000 or more cubic feet of gas per minute.

Figure 8 shows a Western Precipitation Corporation sampling electrofilter with its electron-tube rectifier set, useful in determining the dust, fume, or mist concentration in gases. Its capacity at over 99 per cent efficiency is about one cubic foot per minute. Figure 9 shows a Research Corporation small pipe precipitator with built-in power unit. This particular unit handles about 200 cubic feet per minute at an efficiency of over 99 per cent. Figure 10 shows a Western Precipitation Corporation tar precipitator, with "Unitranset" power unit, which cleans from 5,000 to 10,000 cubic feet per minute of illuminating gas. Figure 11 shows a diagrammatic sketch of a Western Precipitation Corporation precharging precipitator for cleaning about 50,000 cubic feet per minute of cement kiln gases.

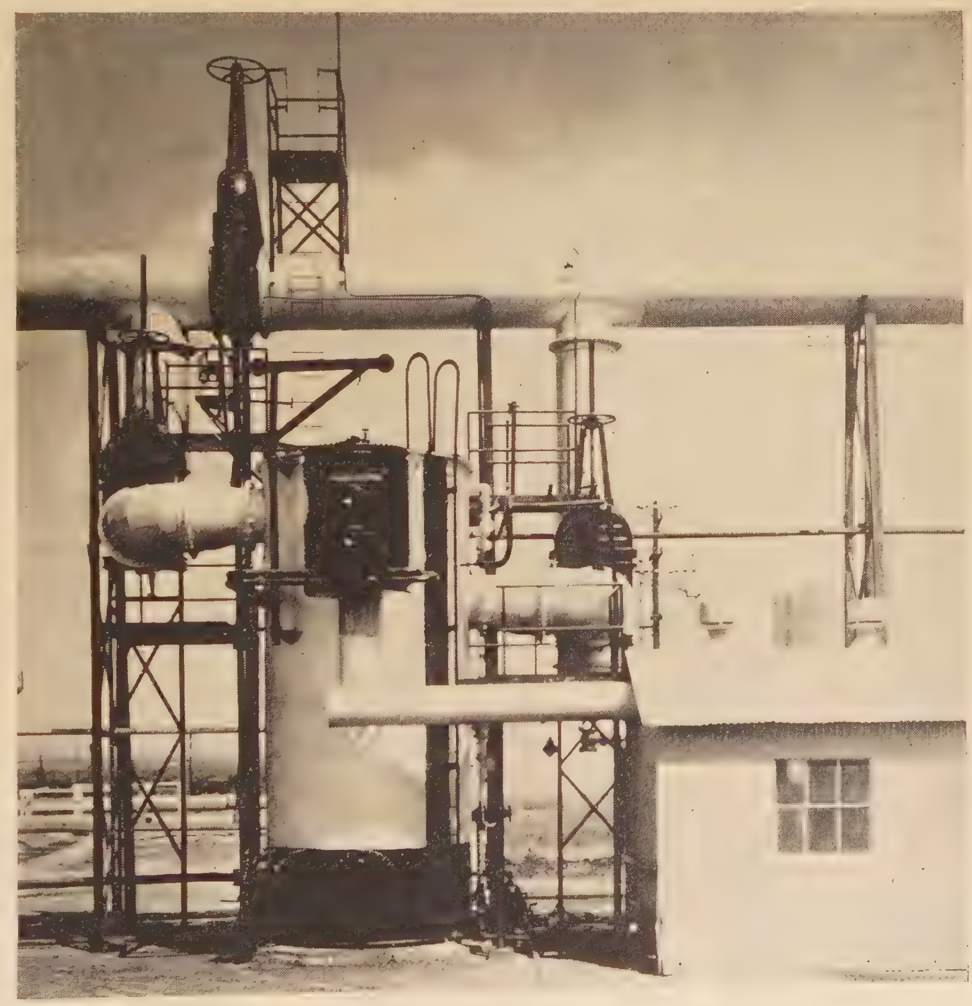


Figure 10. A tar precipitator that cleans from 5,000 to 10,000 cubic feet of illuminating gas per minute

Air-Cleaning Precipitators

Electrical precipitation has found its major application in the more difficult gas-cleaning problems in industry, such as the recovery of valuable materials from waste gases, the prevention of nuisances, and the preparation of gases for subsequent use. In these applications there have been frequent demonstrations of the fact that suspended particles, either liquids or solids and irrespective of size, can be precipitated from gases so completely that only the most minute traces remain. The extensive use of electrical precipitation, for example, for complete removal of arsenic and other catalyst poisons in contact sulphuric-acid manufacture depends on this characteristic. These applications may go somewhat beyond the dust-removal requirements in the relatively new field of air conditioning, but experience with existing systems indicates increasingly the need of refinements in this direction, and of greater air cleanliness than is obtainable by present methods. Similar situations usually have been responsible for the growth of electrical precipitation to its present status, and when the history of its development for this application is written it probably will be a repetition of that of other applications, which have been so extensively described in the literature. Where it was necessary, for example, to control the "dust space charge effect" to make Lodge's initial industrial application practical, it may be necessary in air-conditioning applications to control ozone formation before the other desirable characteristics of electrical precipitation can be utilized fully.

An interesting description[16] of a recent installation of an air-cleaning precipitator was given in ELECTRICAL ENGINEERING for November 1937.

One of the earliest applications of electrical precipitation for air conditioning was in connection with gas masks, during the World War. Lamb[17] and his co-workers developed a small precipitator with tubular collecting electrodes from four to six inches long and energized from dry batteries and induction coils. This precipitator removed such toxic suspensoids as diphenylchlorarsene, which were not removed by the regular gas mask.

Figure 12 shows a precipitator that was operated in 1923 on the ventilating system of a large office building in a central California town. During that period ozonizers were even more popular than now, and one of the objects of the use of that equipment was to determine whether the ozone, incidental to the operation of a precipitator for cleaning the air, would make the cooled but rather humid air from the air washer more agreeable. The precipitator was the single-stage type, and the ozone formation was varied by changing the current; but the occupants of the offices failed to notice any particularly exhilarating effect from the ozone, and the air entering the building was already so clean that the removal of the small amount of impurities present did not justify the continued operation of the equipment.

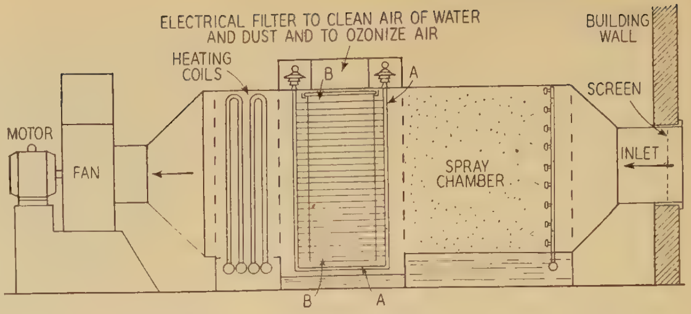

ELECTRICAL FILTER TO CLEAN AIR OF WATER AND DUST AND TO OZONIZE AIR
BUILDING WALL
HEATING COILS
B
A
SCREEN
MOTOR
FAN
SPRAY CHAMBER
INLET
B
A

Figure 12. Diagram of a single-stage plate precipitator as operated on a ventilating system

A—Wire discharge electrodes
B—Plate precipitating electrodes
Both *A* and *B* are placed between sprays and tempering coils in a standard air washer

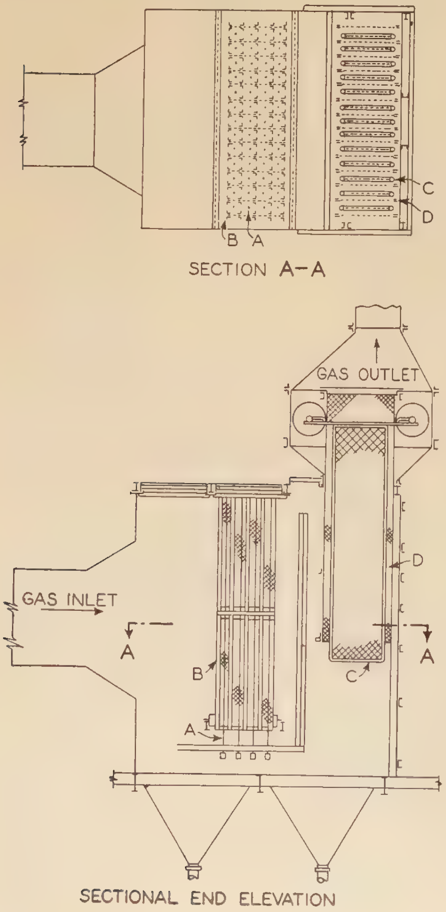


Figure 11. Sketch of a precharging precipitator used for cleaning about 50,000 cubic feet of cement-kiln gases per minute

A—Wire ionizing electrodes in the first stage
B—Screen plate receiving electrodes in the first stage
C—Screen plate precipitating electrodes in the second stage
D—Receiving electrodes in the second stage

Until physiological chemists and ventilating and air-conditioning engineers agree on the function of ozone, the precipitation engineer therefore will have to follow the fashion of the day. For those who "believe" in ozone, he will design precipitators to produce the maximum ozone for a given cleaning effect, while for those who believe ozone harmful, he will design precipitators to give the desired air cleanliness while producing so little ozone as to be undetectable in the treated air by even the most sensitive analytical methods now in ordinary use.

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The Engineer and Trends in Economic Thought

By FRANK B. JEWETT
FELLOW AIEE

A leader in research and past president of the Institute makes several observations on the world of economics and the engineer's relation to it

ALTHOUGH the exact wording of the title which I have chosen for this talk may be a little different from any I have used previously, the subject matter is not essentially new. In common with many of you, I have for years, when suitable occasion offered, voiced my belief about a different position and responsibility for engineers than that which society has in the main accorded us, or in fact than that we have accorded ourselves.

Ten or fifteen years ago this was a pleasant extracurricular activity which not many took very seriously. Now, however, times have changed and I must admit that it is not without trepidation that I again venture into the field. We engineers and scientists, whose training and experience has been largely among the exact sciences, and who deal with problems capable of more or less quantitative solution, are, I think, likely to be irked rather than entertained by a subject which leaves so much latitude for speculation and display of individual preference as does that of the government of society. Nevertheless, we cannot escape an increasing awareness of the fact that in recent years the world outside the totalitarian states is pointing a questioning if not an accusing finger at the engineering profession and its works.

Many Economic Experiments Are Not Scientific

One of our present embarrassments lies in the fact that in the last decade it has suddenly and without real understanding of the scientific method, taken some of our protestations and arguments at more than their face value and has attempted to apply them wholesale far beyond the limits of possible successful operation.

Not only here in the United States but to a greater or less extent in every other country in the world, one of the most ghastly hoaxes imaginable has been perpetrated on society. I refer to the flood of social, economic, and political adventures which have been launched under the banner of "scientific experiments."

That they have been and are experiments, at least so far as this generation is concerned, albeit many of them are hoary-headed failures of the past, no one can deny. That they are scientific is, however, a travesty on everything which we of fundamental or applied science recognize in the term or as the underlying basis for our success in discovering and utilizing the hitherto hidden forces of nature. Over the years we have proclaimed the power of the scientific method and our successes in every domain of fundamental and applied science have been proof of our assertions. With evidence of these achievements in the material world everywhere apparent and with the phrase "scientific experiment" already an accepted byword and an alluring slogan, it was, I suppose, but natural that when existing concepts of social, political, and economic orders began to crack, the slogan should be seized upon by proponents of every new theory and accepted unquestioningly by the rank and file of society. Almost without exception, however, the social and political sorties which have been staged under this stolen banner have been without scintilla of justification of what we of science and engineering understand as the scientific method. To us a scientific experiment is one which under controlled conditions can be repeated at will, and in which but a single unknown factor is involved—or at most a very limited number. It is a method which is never used on a large scale before proved results are obtained on a small scale. It works successfully in our domain not only because of the controls which we impose but also because the things with which we deal are either inanimate or at least without conscious volition.

The charitable thing to say about those who have raised the banner of alleged scientific experimentation in the social and political sectors as justification for radical departures from the experience of the past is that they were ignorant of the fundamental postulates of scientific experimentation. I am not here arguing that many of the social and political things which the world has tried out in recent years should not have been attempted, but I do think it a tragedy of the first order that they were undertaken on an argument so fallacious as that they were scientific experiments. The tragedy lay both in leading vast numbers of people to believe that more could be accomplished than was inherently possible and in violation of another fundamental tenet of scientific experimentation; namely, frank and honest stoppage of an experiment when it is clear that it is going wrong.

Does Science Contribute to the Economic Well-Being of the World?

All that has happened in the last decade has tended unquestionably to bring certain aspects of science and the scientific method under a suspicion which is as undeserved as was the claim of infallibility which preceded it.

Essentially full text of an address delivered at a meeting of the Western Society of Engineers, Chicago, Ill., May 5, 1938, at which time the Washington Award for 1938 was presented to Doctor Jewett "for inspiring and directing scientific research leading to improvements in the art of communication." A biographical sketch of Doctor Jewett appeared on page 83 of the February 1938 issue of ELECTRICAL ENGINEERING.

Under the circumstances, and however unwelcome the task may be of exonerating science and ourselves from these suspicions, we can hardly remain oblivious of the issue that has been raised.

Although the world continues to welcome enthusiastically the material conveniences which the scientist and engineer are conferring upon it, there is an undercurrent of uncertainty and suspicion in present-day public opinion regarding the true social value of many of our technological contributions. To be sure, there is something ironic in the picture presented by a man who is awakened by an electric alarm clock, shaves by choice with an electric razor and with electrically heated water, breakfasts off dishes prepared on electric appliances, is transported to his office in an automobile and by electric trains and elevators, there to transact most of his business by telephone and with the aid of innumerable mechanical gadgets, but who in his spare moment conjures up visions of dangers inherent in an over-reliance upon technological aids and conveniences. But while we may smile at this we cannot close our minds to such influence as that which the motor car has had, not so much upon safety as in the way of increased temptation to crime and moral laxity. Further, the introduction of cheap printing methods and the emergence of radiobroadcasting and talking motion pictures from science, have displaced the lyceum platform and the more substantial literature upon which our forbears depended for intellectual guidance. Evidence is not lacking that the ever-mounting flood of reading matter and predigested information may be diluting the intellectual fodder chosen by great numbers of people. If the first impact of rayon on the textile world, as a substitute for silk, had remained its sole or principal impact, its development would still have been a noteworthy scientific achievement. When, as now, it is mixed with or substituted for all other fibers to the end that cheaper products are available—but products which we sometimes suspect supply less of real value for the customer's money than previously—it is not surprising that thoughtful people may sometimes classify it with other things of science to be questioned. In this recital I should be less than gracious if I made no reference to the telephone and telegraph, which in their ubiquitousness have unquestionably undermined to some extent one of the best of ancient arts—that of letter writing.

I would not, however, ask that you take my words alone. Let me quote from a recent article by Gilbert Murray in which he weighs the pros and cons of technology.

> "In this machine age man has had to pay a heavy price for the help given him by his machines. Take a well-fitted modern observatory; a telescope with a very large lens, a clockwork arrangement enabling it to follow exactly some particular part of the sky, a fine photographic apparatus to record the light of the stars, even stars quite invisible to the eye. A man looks at the photograph and discovers on it a new star. A great achievement, but due chiefly to the machine, not the man. Such a man is not using nearly as much mind, as much thought and brain power, as an ancient Greek or Chaldean astronomer who with no instruments at all observed and calculated nearly right, if not quite right, the main movements of the heavenly bodies. Think of a stupid fat man driving fast in a beautiful motor car which he does not understand; or the millions of clerks who are carried blindly to their work every day by train or bus: they are not using nearly as much intelligence as the man of a hundred years ago, walking on his own legs, looking about him, noticing plants and trees and birds. No doubt immense skill and brain power have gone to making the instrument—the telescope, the motor car, or steam engine; but the instrument, when made, actually diseducates the user. It enables him to do what he wants, or get where he wants, almost without using his mind or brain or limbs at all. And if he need not use them you may be sure he won't use them."

I have quoted this to illustrate a point of view commonly expressed and not because I agree wholly with Murray. I think the very point he makes could be turned against him.

Economic Discontent Is Not New

Before going any further in our survey it may be well to reassure ourselves with the reflection that anxiety concerning moral decadence following technological advances is no new thing peculiar to our day and age. We all know that it has long been customary to sigh for the "good old times." I recall having once read of a Chaldean tablet which when deciphered must have astonished its translator with its decidedly modern flavor, for it bore the following message:

> "We have fallen upon evil times. Public officials are no longer honest and children no longer respect their parents."

Further, one of the most astounding things which a visit to Egypt or a study of the records of archeological exploration there discloses, is the vast record of social and political experiments, successful and unsuccessful, which were tried millennia before Christ was born. One has but to read the story of Akhaaton, the great iconoclastic Pharaoh, 1375 B.C., to sense that he would have been a valiant leader in many a modern adventure.

Coming to a somewhat more recent age, many of you doubtless have seen the statement quoted recently by Sir Josiah Stamp:

> "Travelling in these Coaches can neither prove advantagious to Men's Health or Business; For, what advantage is it to men's Health, to be called out of their Beds into these Coaches, an hour before day in the morning, to be hurried in them from place to place till one hour, two or three within night; insomuch that after sitting all day in the Summer time stifled with heat, and choked with dust; or the Winter time starving and freezing with the cold, or choked with filthy Fogs, they are often brought into their Inns by Torchlight, when it is too late to sit up to get a Supper; and next morning they are forced into the Coach so early, that they can get no breakfast. What addition is this to Men's Health or Business, to ride all day with strangers, oftimes sick, ancient, diseased Persons or Young Children crying. . . . Is it for a Man's Health to travel with tired Jades. . . . .
>
> "For passage to London being so easie, Gentlemen come to London oftener than they need, and their Ladies either with them, or having the Conveniences of these Coaches, quickly follow them. And when they are there they must be in the Mode, have all the new Fashions, buy all their Cloaths there and go to Plays, Balls and Treats, where they get such a habit of Jollity, and a love to Gayety and Pleasure, that nothing afterwards in the Countrey will serve them."

Because it antedates the present by just a hundred years, perhaps the most interesting of all the expressions of foreboding are some passages to be found in Macaulay's essay on "Southey's Colloquies on Society." Speaking of Southey's opinion of the manufacturing system, Macaulay says:

> "There is nothing which he hates so bitterly. It is, according to him, a system more tyrannical than that of the feudal ages—a system of actual servitude, a system which destroys the bodies and degrades the minds of those who are engaged in it. He expresses a hope that the competition of other nations may drive us out of the field; that our foreign trade may decline; that we may thus enjoy a restoration of national sanity and strength."

Time does not permit quotations of any of Southey's own arguments against the changes of his time. Macaulay, of course, takes emphatic exception to Southey's views, and in a passage which for eloquence and appropriateness to our own situation it would be difficult to excel, he says:

> "The present moment is one of great distress. But how small will that distress appear when we think over the history of the last forty years; a war, compared with which all other wars sink into insignificance; taxation such as the most heavily taxed people of former times could not have conceived; a debt larger than all the public debts that ever existed in the world added together; the food of the people studiously rendered dear; the currency imprudently debased, and imprudently restored. Yet is the country poorer than in 1790? We firmly believe that, in spite of all the misgovernment of her rulers, she has been almost constantly becoming richer and richer. Now and then there has been a stoppage, now and then a short retrogression; but as to the general tendency there can be no doubt. A single breaker may recede, but the tide is evidently coming in."

And then continues in the oft-quoted passage which, as you may remember, was written in 1830:

> "If we were to prophesy that in the year 1930 a population of fifty millions, better fed, clad and lodged than the English of our time will cover these islands; . . . that machines constructed on principles yet undiscovered will be in every house; that there will be no highways but railroads, no traveling but by steam; that our debt, vast as it seems to us, will appear to our great grandchildren a trifling encumbrance which might easily be paid off in a year or two—many people would think us insane. We prophesy nothing; but this we say: if any person had told the Parliament which met in perplexity and terror after the crash in 1720 that in 1830 the wealth of England would surpass all their wildest dreams; that the annual revenue would equal the principal of that debt which they considered as an intolerable burden; . . . that London would be twice as large and twice as populous, and that nevertheless the rate of mortality would have diminished to one-half of what it then was; . . . that stagecoaches would run from London to York in twenty-four hours; that men would be in the habit of sailing without wind, and would be beginning to ride without horses—our ancestors would have given as much credit to the prediction as they gave to Gulliver's Travels. Yet the prediction would have been true. . . ."

Were he here today I doubt not that Southey would certainly have been delighted with many of the experiments in government which we are witnessing, for, according to Macaulay, Southey viewed government as a "jack of all trades."

> ". . . . . architect, engineer, school-master, merchant, theologian, a Lady Bountiful in every parish, a Paul Pry in every house, spying, eavesdropping, relieving, admonishing, spending our money for us, and choosing our opinions for us. His principle is, if we understand it rightly, that no man can do anything so well for himself as his rulers, be they who they may, can do it for him, and that a government approaches nearer and nearer to perfection in proportion as it interferes more and more with the habits and notions of individuals."

How close home this strikes! Macaulay counters with a proposal which also has come to possess a singular familiarity:

> "It is not by the intermeddling of Mr. Southey's idol, the omniscient and omnipotent State, but by the prudence and energy of the people, that England has hitherto been carried forward in civilization; and it is to the same prudence and the same energy that we now look with comfort and good hope. Our rulers will best promote the improvement of the nation by strictly confining themselves to their own legitimate duties, by leaving capital to find its most lucrative course, commodities their fair price, industry and intelligence their natural reward, idleness and folly their natural punishment; by maintaining peace, by defending property, by diminishing the price of law, and by observing strict economy in every department of the State. Let the Government do this: the People will assuredly do the rest."

In spite of Macaulay's complacent reassurances, I doubt that any of us fail to recognize in the present situation, both at home and abroad, the existence of forces of unrest which are far deeper than could arise merely from discordant political shibboleths. Many if not most of these trace back to the doorstep of the engineer and scientist because it is around the things of their creation that the maelstrom surges most violently.

Expanding Technology Necessitates Better Planning for the Future

By creating cheap and abundant mechanical power and the countless industrial operations made possible by it, we have let loose social forces of stupendous magnitude with which the world has not, as yet, had sufficient experience to be certain even of their direction, let alone their magnitude.

Our present difficulty, as I see it, is not that we scientists and engineers have produced too many things too fast, and that there should be a holiday in applied science, but rather that we, in common with the world at large, have failed to take seriously enough the matter of foreseeing and providing for the more important social consequences of our material achievements. If this is, as I believe it to be, a valid criticism of social action during the past 150 years, then we of science and engineering, more possibly than most other groups, have something to account for. When, 25 or 30 years ago, I began to voice questionings of this kind and to argue for a broader conception of the engineer's function than I had been trained to, the answer which I received more commonly than not, even in educational institutions, was that the primary function of an engineer was to confine himself to the production and operation of the things of applied science, and let others worry about the social and political adjustments. I thought then, as I think now, that any argument along this line involves a fallacious assumption, namely, that nontechnical people, in addition to whatever competence they may have in their own fields, can be assumed to have as much competence about applied science instruments as those who create these instruments.

After saying this, let me hasten to add that I would not have you for a moment think me an advocate of turning over the operation of social or political matters to scientists or engineers. In my judgment, and speaking as one of the breed, I think that as a group, in which however there are many notable exceptions, we are probably less qualified than other groups to handle problems so far removed from the realm of controllable things with which we are accustomed to deal. All that I am trying to express is that we as scientists and engineers, both in our current functioning and in setting up the education of those who will follow us, should have a somewhat different concept of social responsibility than in the past. Further, that society generally, since it must continue to live with the things of applied science, will be well advised if it seeks seriously to find a way of enabling us to apply such talents as we may possess a bit beyond the realm of creating new instrumentalities.

We, and particularly we here in America, are all entirely familiar with what applied science has already done in bringing not only the so-called comforts of life, but also many of its luxuries as well, virtually within the reach of every one. In fact we have come so close already to realizing the age-old dreams of plenty that mass patience breaks down even at the prospect of small delays or deprivations. So far as I can see, and while I no more than others can forecast the future in detail, there is no present reason to believe that we are nearing the end of the stream of new things. If this is so then our problems of social adaptation will continue with us for an indefinite period. Under such circumstances common sense would seem to indicate the desirability of organizing for the future a bit better than we have in the past. If we do there are I think two factors among others which we must keep always before us: (1) that there are no safe short cuts to a desired goal over untrodden terrain; and (2) that men's sense of values is entirely relative. We human beings are not at all interested in contrasting our present situation with that of our fathers or grandfathers. The only thing which appeals to us is the contrast of our present situation with that of a year or so earlier, or with that of our immediate neighbor.

Economic depressions are not new phenomena, nor are they likely to cease with the passing of the present one. It was not very long ago that hard times meant not only misery but also virtual starvation for multitudes. In the western world at least, the tragic phase of starvation has happily passed but that does not mean that the discontent and suffering of a depression period has been lessened for those involved in it.

Science Is a Vital Factor in the Economic Balance of a Nation

Let us turn now to the question of economic balance and its upsetting—a field in which the results of the engineer's work are unquestionably a major factor. I do not wish to imply that all or even a majority of technology's contributions have raised difficulties concerning industrial assimilation. When we recall the disturbing influences to which our single most fundamental and most necessary industry—agriculture—has been subjected, however, partly by development of improved methods of culture, partly by rapid and cheap transportation with consequent increase in the scope of competition, partly through direct application to the work of the farm of power which must be purchased abroad rather than created at home, and partly through the development of such an industry as that of rayon, which has already usurped a considerable portion of the domestic market for cotton, wool, and linen, we can be pardoned for expressing amazement that adjustments, both national and international, have remained as stable as they have.

Or, turning to the problem of employment, where labor has been geared more and more to machine production and has become correspondingly helpless without the machine's aid, we who have been the creators of machines certainly invite the raising of a none-too-pleasant reckoning with a novel aspect of the law of diminishing returns. Whatever the relief which a more remote future may hold in store for us, we must today, if we are honest, admit the peril of a fundamental danger. In many respects a nation or a society has the characteristics of an individual. With an individual, liability to contract many diseases is in direct relation to the undermining of normal bodily health; so with a nation. Although we here in the United States have not gone nearly so far as many elsewhere in the world, we have nevertheless joined the ranks of those nations whose political and industrial constitutions have become undermined. Such a condition incites a certain morbidity of thought. Like the man who in good health has no difficulty in avoiding the temptations of the "quack," but who through suffering from prolonged illness becomes desperate and yields to the allure of unscrupulous blandishments, we as a nation are facing a type of danger which was nonexistent in more prosperous times.

Here in America, confronted though we are with the same problems that have bedeviled the rest of the world and driven nations over the precipice of despair of themselves, their institutions, and their traditions, we are still blessed beyond all others in many vital things. We have an abundance within our borders of most of the major elements of virile economic life; substantial freedom from the hideous nightmare of impending war; a vast but not too vast population of intelligent educated men and women living in a single ample area; the tradition of centuries of law and government operating in a democratic society not to do things for people but to enable them to do things themselves and best of all, freedom still of thought, inquiry, and expression for the individual with a maximum of opportunity for each to play his or her part with a minimum of imposed restraint and regimentation.

The fact that during the past decade or two we have worshipped numerous false gods and chased many will-o'-the-wisps that seemed to offer us a short cut to the pot of gold at the foot of a rainbow should not cause us to lose our sanity, our sense of proportion, our tolerance of others, or our courage.

In the challenge of the turbulent years ahead, we of science and engineering cannot escape playing a prominent part. Whatever some distant future historical appraisal may say of us and our works, past, present, and future, it must say something, for we *have* created many things that have developed economic, social, and political problems of the first order. I hope it can say something laudatory of our contributions to their solution.

That we will continue in the future as in the past to delve into Nature's unknown and to employ what we find in new things for society to use or misuse, goes without saying. We will do this partly because we are curious, partly because it is our field of adventure in life and partly because as a group we have a deep-seated innate conviction that society will profit by having a greater variety of more goods and more things to lighten human toil and enlarge the sphere of opportunity for enjoyment of life. It cannot be otherwise, for if we did not feel so we would seek adventure elsewhere. We are not scientists and engineers rather than merchants, lawyers, farmers, artisans, or other honorable workers merely for the sake of earning food, clothing, and shelter.

The fact that many of the things we have or will create can be used to the detriment of society as in war, or by criminals, or temporarily in foolish ways not in its permanent best interest is nothing new, and no valid argument against producing new things. One has only to view the vast array of pictorial evidence in the tombs and on the monuments of Egypt which take us back to the beginning of human history to see that it has always been so. Nor can any one deny that slowly through unnumbered millennia the progress of society and of individual freedom has been upward, despite periodic dark ages, and has been most evident in those peoples who were creators of new things. When they ceased to create, the nations they constituted ceased to lead.

Where Does the Scientist Fit Into the Economic Pattern?

It is outside this essentially normal sphere, however, that the great challenge and great opportunity for scientists and engineers exists in the years ahead. It is the challenge and opportunity to contribute something more than we have of our special knowledge and special skills to the solution of intricate economic, social and political problems, many of which arise directly from our work as scientists and engineers.

On the positive side and with rigid adherence to the critical standards we must impose in our work, we frequently can provide valuable information of what can or cannot be expected economically or socially from our creations. Our views applied merely to the obvious outward manifestations of our works may be no better than those of others, and frequently are not so good. What we have—or should have—that others do not possess, however, is real information as to how far and in what way these surface manifestations are likely to be modified by advances in science itself. All of us—at least those of my generation—can recall instances of grave economic, social, and political errors arising out of assumptions as to the future which could have been avoided had knowledge of probable future developments in the possession of the more competent scientists and engineers been brought properly into the picture. That it was not was due either to lack of adequate machinery or a feeling on the part of the men in question that the matter was outside their province.

It is on what might be called the negative side that we may be able to make the greatest contribution to the orderly solution of economic, social, and political problems. We, more than any others, know the power, possibilities, and, above all, the limitations of science and of the scientific method of attack. This is not because we have any superior wisdom but merely because we have been specially trained in the knowledge and technique of science and its arts. We know that the great achievements of science and engineering are never the results of brilliant chance unrelated to previously established knowledge. Irrespective of how radically new they may appear to the uninitiated, they are always direct lineal descendants of what has already been proved. Usually they are not really very great adventures beyond it. To venture further is to become a gambler rather than a scientist or engineer. Even when occasionally for reasons beyond his control the scientist or engineer is forced to go further than prudence dictates, he always injects "factors of safety"—really "factor of ignorance"—and is the first to beat a retreat to firm ground when danger threatens.

Having to operate in a field where Nature's inexorable laws are swift to punish transgressions and cannot be hoodwinked even temporarily, as is sometimes possible in the social and political sector, we are acutely conscious of the dangers inherent in large-scale excursions into untested regions, particularly when many unknown and so uncontrollable variables are sure to exist. We have learned through sad experience the virtue of the old motto about the shortest way home and the value of the succession of small-scale laboratory trials as a necessary prelude to successful large-scale use. It is only through them and the opportunity they afford of unearthing and correcting individual small difficulties and mistaken assumptions which saves us from having them pile up in great failures. It is an axiom in science and engineering that what can be done in a laboratory may be done on a large scale; what cannot be done there cannot be done on a large scale.

Further, we know the amount of time which must elapse in the laboratory stage of any new development before practical application can be undertaken safely. We are prone to emphasize this and the multitude of difficulties to be overcome. Actually both are great, but relative to the corresponding factors in social and economic problems they are few and simple.

Out of all this experience should come in the years ahead an enlarged opportunity to apply it in the social, economic and political fields if in no other way than by influencing sincere men and women to avoid undertakings which in the very nature of things are doomed to failure because of the unknown or uncontrollable factors inherent in them. It is a challenge to us and likewise to our whole scheme of universal education.

Whether we like it or not our world and that of our children will be increasingly shot through with major social problems arising from use of the "gadgets" we create. We, and the society of which we are a part, will fall short if it and we fail to evolve a more orderly method of solution than that of the jungle, merely because we lack the wit and will to apply established knowledge and proved technique to it.

In our plans for a better and more efficient future we need not concern ourselves much about technical education per se. That will take care of itself automatically. The great problem, as I see it, is the education of the general population—those who are not to be practitioners in the field of science, but whose decisions control the current of its application.

The problem is in essence a simple one, although its solution is most difficult, both on account of sheer magnitude and because of past and present errors. It is the problem of indoctrinating the thinking part of the population with a modicum of better understanding of science and its techniques—of its powers and limitations. All that is required is something sufficient to offset the superficial assumptions engendered by outward appearances and to impel men and women to seek advice from those in position to have it and to ponder this advice before acting.

It is something in which we can help and something to which our great foundations can well give attention. Solution need not contemplate implanting much, if any knowledge of the detailed facts of science. It will, however, be likely to do violence to much of current pedagogical theory and practice which has been badly bitten by the bug of unscientific methods masquerading under the banner of science.

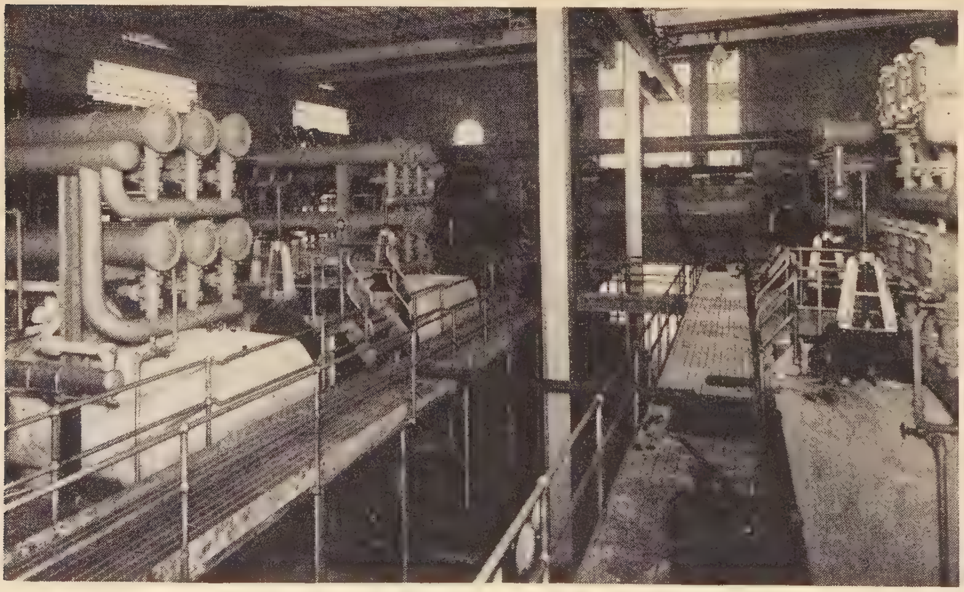
My interest in museums of science and industry is grounded in the hope that they in time may add a mite to a better understanding. They are still far from doing all that is possible and their progress will always be limited by the previous understanding of their visitors.

I for one am a confirmed optimist in believing that we can, and will, succeed. I say this with full recognition of the difficulties to be overcome, of the time involved and of the discouragements in the way. If I have learned one thing from forty years of struggle in science and engineering, it is not to expect to reach the promised land by lunch time or over a smooth highway unencumbered by traffic lights or detour signs. These may be irritating and cause us to arrive later than we hoped, but they do insure a safe arrival for us and our children also.

New Equipment to Keep Legislators Cool

RECENTLY completed in the power plant serving the national capitol is the refrigerating machinery shown on this page. Claimed by the manufacturer to be the world's largest single installation of refrigerating machinery for air-conditioning purposes, this apparatus will cool more than 11,000,000 gallons of water per day—enough to air-condition the United States Capitol, the Senate Office Building, and the old and new House Office Buildings.

The compressors are driven by six 1,000-horsepower 6,660-volt 25-cycle synchronous motors, excitation for which is supplied by a 100-kw motor generator set. Pumps, driven by steam turbines, draw condensing water from the Anacostia River through more than half a mile of 30-inch pipe. The water is distributed to the condensers and finally returned to the river by gravity. Similar pumps force the chilled water, at a temperature of 40 degrees Fahrenheit, through 24-inch supply mains to air-condition the buildings and return the warmed water to the coolers; during this cycle the cooling water makes a round trip of more than a mile.



All the cooling equipment as well as auxiliary equipment is contained in a space 120 feet long by 78 feet wide and a net operating height of 16 feet. Interesting side lights: The equipment is so compact that its daily output is equivalent to the melting of a block of ice greater in volume than the space required for the cooling machinery itself. The power plant has a pumping capacity equal to that of a water system supplying a city of more than 200,000 people, allowing the standard of 60 gallons per person per day.

Rural Electrification in England

A review of the present position of rural electrification in England, giving special attention to the economic aspects of electrification in rural areas, and describing a typical British rural electric system

THE PROVISION of public supplies of electricity throughout rural areas is regarded in all progressive countries as an urgent and important necessity for the general welfare. In Great Britain powers have been granted to various authorities covering almost the entire country, and reasonably good progress is being made in extending electric service to the rural areas, as reported in a paper by J. S. Pickles entitled "Rural Electrification," which was read in London before the Institution of Electrical Engineers, December 2, 1937. The term "rural electrification" frequently is misapplied to areas that would be more correctly described as urban or suburban. Throughout the paper the author uses the term "rural electrification" in application to large areas devoted principally to agriculture, and mainly containing only scattered population.

The density of population of a rural area commonly is expressed in persons per square mile. The figure obtained by dividing the known population by the total area is held to be misleading and as giving an erroneous impression of the actual area because many rural areas possibly contain portions of hilly or marshy country that is virtually unoccupied. A safer working figure is obtained by excluding such unoccupied territory and determining the population per square mile of the effective area. As used here such a figure is referred to as the *effective* density of population. For example, in the Dumfries County area, the actual density of population is 55 persons per square mile, but if the mountainous and virtually unoccupied parts are excluded, the effective population is approximately 100 per square mile. A distribution in which one half of the population of the area is in towns and villages and the other half is scattered over the remainder of the area is considered, for convenience of reference, to be a *normal* distribution.

Most of the early engineering difficulties associated with rural electrification in England have been solved satisfactorily against handicaps not ordinarily imposed upon engineers in the United States. British villages are more densely built, with narrower streets; rural highways are narrower and more winding; and the rules of the Board of Trade and the Postmaster General are more restrictive and conservative than are the public utility regulations in the United States. The one major problem that appears to have defied complete solution in England is protection against lightning discharges. Though damage from lightning strokes may be partly mitigated in some rural areas, it still is a very serious trouble to engineers in charge of large interconnected overhead networks. Another remaining problem is that of providing satisfactory protection to the consumer in areas where earthing conditions are poor, but much progress now has been made toward its solution.

"Financial" Engineering Important in England

The principal difficulty in the electrification of rural areas in England does not involve engineering technique, however, but the financial problem of "making ends meet." Successful rural development is a continual struggle on the one hand to keep down the necessary capital cost to a minimum, and, on the other hand, to insure the early and rapid development of revenue. Economy in capital is extremely important, and all means to that end consistent with reasonable reliability of supply must be employed.

At first sight rural electrification might still appear to be a risky financial venture in view of the many miles of mains required and the comparatively high cost of distribution. Fortunately, as regards capital costs, practice has shown that with extensive use of overhead lines and careful design, the total capital cost per consumer can be restricted to a figure not much greater than the corresponding cost for the densely populated areas in which relatively expensive underground cables are necessary. Although there are many apparent difficulties, domestic revenue per customer can be much higher in a rural area than in a town or urban area. This is not because wages are higher, since the contrary usually applies, but is due to several contributory factors. Competition against gas as a heating or cooking fuel is entirely absent, or is not so intense as in urban areas; coal is expensive; there are fewer outlets for the spending of wages; the home is used much more; and the many comforts that can be provided by electricity are more eagerly sought.

Increasing Farm Loads— A Promising Source of Revenue

In any rural area the farms, even on the basis of numbers only, represent a material proportion of the total available consumers. Moreover, farmers own or are responsible for the tenancy of most of the agricultural workers' cottages, and the whole welfare of the countryside revolves around agricultural progress; therefore, no plan of rural electrification can be considered to be successful unless a deliberate attempt is made to obtain the connection of the greatest possible number of farms.

Although it might appear that much has been done already in the extension of electric service to farms, the progress hitherto made really is only a small part of what remains to be done. Completely authentic records of farm connections are not available, but the following figures are believed to be substantially correct: In 1926, 600 farms connected; in 1932, 4,000; 1936, 25,000; 1937, 30,000. Since in Great Britain there are nearly 450,000 farms and small holdings of over one acre, obviously only a small part of the total is connected to a public supply.

Engineering Features of Rural Systems

The principal part of the large-scale distribution system is a high-voltage network of three-phase overhead lines, operating at 11,000 volts, since that is the highest standard voltage at which lines can be tapped economically for isolated customers. Steel-cored aluminum conductors at present are used extensively. Conductor sizes need not be large, since such lines seldom are deficient in current-carrying capacity, and relief from the possible trouble created by voltage drop can be obtained more economically by the use of automatic tap-changing boosters than by the provision of large conductors.

Table I. Relative Figures for Three Different Systems of Supply, Assuming Equal Lengths of Low-Voltage Distribution Main With Balanced Loading

	Number of Conductors	Relative Capacity	Relative Cost
Single phase	2	1	1
Single phase	3	4	1.26
Three-phase	4	6	1.51

For high-voltage spur lines galvanized steel conductors have been found to be suitable in every way and will withstand snow storms more satisfactorily than many other types. The author urges that, in the interest of economy, all spur lines should be single phase—even in route lengths up to ten miles—in serving only sparsely populated parts of the area. Exceptions should be made only of those lines which ultimately may form parts of the general three-phase network. In towns and principal villages electric supply normally is provided from three-phase low-voltage networks, but in small villages the author strongly advocates extensive use of the single-phase three-wire method of distribution. It is further suggested that all isolated consumers such as farms and country houses should be supplied by single-phase 11,000-volt tappings.

In villages the two-wire single-phase system is satisfactory for small groups of houses up to, say, ten in number. For larger groups forming small villages having up to 50 houses, the single-phase three-wire system is recommended, with 230 volts between each phase wire and neutral and 460 volts between lines. Table I shows a comparison of alternative systems of supply assuming equal voltage drop, and shows that the single-phase three-wire system costs only 26 per cent more than the two-wire system, but the relative current-carrying capacity is quadrupled.

The provision of three-phase supplies would involve an increased cost not only for the low-voltage distribution main, but also for the high-voltage spur line and transformer.

Electric supply to isolated country houses and farms almost without exception should be given by a single-phase 11,000/230-volt two-wire tapping of the high-voltage main. In houses a motor load is unusual, and the domestic requirements can be supplied by single phase with less likelihood of voltage fluctuation than if such load were split over a three-phase service. Properly balancing three phases is particularly difficult where cookers, which normally must be connected to only one phase, are used. This usually requires a larger transformer than would be necessary with the single-phase system, which allows some diversity advantages.

Precisely the same arguments apply to all farm load, with the exception of motors, which will be required eventually. Much misapprehension exists in relation to the motor load, and it is feared that without proper consideration three-phase supplies frequently are provided to farms with much unnecessary capital cost. The power requirements of most farms can be supplied readily by a motor of some five to seven and one-half horsepower, and there are relatively few farms requiring motors exceeding ten horsepower in size. Single-phase motors now are available with much improved starting characteristics, and the slight extra cost incurred by the customer is fractional compared with the aggregate saving to the supply authority in capital cost of mains and services. This saving is reflected back to the customer by a reduction or complete elimination of the service connection charge.

Rate Determinations Are Important in England

In Great Britain electrical operations are more generally under the management of electrical engineers than are electrical properties in the United States, where public utility properties in many instances are under the management of bankers and lawyers. Having in mind that in any rural area the domestic load from small premises will predominate in both consumption and revenue, correct practice in the use of slot meters is of the utmost importance. Indeed the correct use of slot meters is believed to be the key to increased revenue and a vital factor in the success of rural plans.

The principal types suitable for the development of general domestic loads fall into the following groups: (*a*) stepped-rate, (*b*) double-circuit, (*c*) change-price, (*d*) two-part. Results regarded with satisfaction have been obtained with each of the types. Much satisfactory development has been achieved even by the use of a flat-rate meter giving domestic supplies at an equated rate of one penny per unit or less. That method, and each of the types (*a*), (*b*), (*c*), have limitations which either do not permit their use by each and every domestic customer, or do not encourage the maximum domestic use obtainable by a straightforward two-part tariff. The two-part tariff meter, arranged so as to collect a fixed and a running charge ["fixed charge" and "running charge" in British nomenclature correspond in a general way to the American "demand" and "energy" charges, respectively] appears to be the only one enabling the supplier to offer the slot-meter consumers precisely the same terms as are usually available to those consumers who choose to pay their accounts quarterly, and this consideration appears to place this type first in order of preference. With this type, any two-part tariff containing a fixed annual or quarterly charge can be resolved to a weekly basis, and the slot consumer thereby is offered precisely the same terms as the quarterly consumers.

Maximum Demands

Estimates of the maximum demand likely to result from service to a given number of consumers are always a source of speculation. Large errors can be made, usually in overestimating the demand, unless adequate allowance is made for diversity. The diversity of use even in a single household is surprising, and if allowance is made for the additional diversity between separate consumers, and also between different parts of a large supply area, the result is remarkable. In a city or urban area where fixed times for the commencement and cessation of business affect the majority of consumers there is not the same diversity as in a rural area where habits may vary greatly between different parts and therefore the diversity can be very large.

Table II. Total Connected Load, Resulting System Maximum Demand, and Various Derived Figures

	Year of Trading				
	Preliminary	First	Second	Third	Fourth
Connected Load (Kilowatts)					
Lighting	333	1,319	2,068	2,523	2,700
Heating	236	1,027	3,384	4,800	5,638
Motive power	114	819	1,424	2,117	2,519
Cooking	650	2,325	4,100	9,505	12,630
Total	1,333	5,490	10,976	18,945	23,487
System Maximum Demand (Kilowatts)					
Total	150	780	1,409	2,445	2,571
Per consumer	0.20	0.30	0.30	0.39	0.34
Per head of population	0.003	0.013	0.024	0.042	0.044
Diversity					
Ratio of connected load to system maximum demand		7.0	7.8	7.8	9.1

The figures of connected load and resulting system maximum demand shown in table II relate to a large rural area of approximately 1,000 square miles. Obviously there has been some difficulty in obtaining accurate records of the connected loads for those items of domestic equipment, notably heating units, which consumers purchase and use without notification, and a little estimating has been necessary in computing that item. All other items are known to be fairly accurate, especially the predominating figures relating to cookers. The system maximum demand tends toward a figure of about one-tenth of the total connected load.

The Dumfries County System

During the last five years a complete electric distribution system has been put into operation in Dumfriesshire by the county council of that area. This system is of special interest because the supply area, which covers an entire geographical county with the exception of one town, is a self-contained area in which no electric service had been available previously. The policy toward consumers, which aims at providing service to all consumers within the area on equal terms, is notable in that supply has been given to every consumer without any contribution toward capital cost, irrespective of the length of the necessary service main, and without the payment of any guaranteed minimum revenue.

The supply area is 1,070 square miles in extent and has a population (1931 census) of only 58,252. The area is almost entirely agricultural in character, with a little associated industry in a few creameries, sawmills, quarries, and grain mills. The total number of occupied dwelling houses within the area is 14,176, and the total possible number of consumers may be taken at the round figure of 15,000.

The tariffs, which have remained practically unchanged since the beginning, are shown in table III. The flat rates are kept comparatively high to encourage the free adoption of two-part tariffs. Two-part-tariff prepayment meters are provided without extra charge.

Table III. Schedule of Tariffs

Premises	Fixed Quarterly Charge	Running Charge (Pence per Unit)
Dwelling houses	5s. per room (maximum 20 rooms) boxrooms, bathrooms, sculleries, attics, and cellars not chargeable	$^{3}/_{4}$
Farms	7s. 6d. per room. All use, including motive power, allowed at normal running charge ($^{3}/_{4}$d. per unit)	$^{3}/_{4}$
Trade or business premises	5s. per 100 square feet for first 1,000 square feet 2s. 6d. per 100 square feet for all additional	$^{3}/_{4}$
Other premises	One-half of charges under previous item	$^{3}/_{4}$
Street lighting	7s. per lamp. Street-lighting authority to provide equipment	$^{3}/_{4}$
Alternative flat rates	Lighting 8d. per unit, heating $1^{1}/_{2}$d. per unit	—
Motive power	Block rate, sliding from $2^{1}/_{2}$d. to $^{3}/_{4}$d.	–

TRANSMISSION AND DISTRIBUTION SYSTEM

Bulk supply is obtained from the Central Electricity Board. The high-voltage network, which is almost exclusively overhead, consists of one 33-kv feeder 20 miles long, a general 11-kv three-phase system totaling 304 route miles, and several single-phase 11-kv spur lines totaling 191 miles. The aggregate length of low-voltage lines is 163 miles. All isolated consumers such as in country houses, farms, and small groups of houses, are supplied by single-phase tappings of the 11-kv network. Low-voltage distribution is done on the three-phase system in burghs and large villages, and by the single-phase three-wire system in small villages, at the standard voltage of 230.

Working Results

Part of the year 1931 and the entire year of 1932 were occupied in constructional work on the Dumfriesshire system. First supplies under the principal plan were made available in February 1933. The period prior to 1933 has been regarded as preliminary, and the first full year of trading was the year ending May 15, 1934. The undertaking is now in its fifth year, and the actual working results given hereafter are for the first four years, with estimated figures for the fifth year. By the end of the fourth year 7,508 consumers, or 50 per cent of the total possible number of consumers in the whole area, had been connected to the supply. It is estimated that by the end of the fifth year the number of consumers will have increased to 8,500, or 57 per cent. Moreover, distribution mains have been provided from which a large number of other consumers may be connected at little more than the cost of services. It is estimated that already a supply is available from existing low-voltage mains to not less than 11,000 premises, representing 73 per cent of the total possible consumers in the whole area. Domestic use accounts for 83 per cent of the total energy sales, while power consumers, who are few in number and whose load is small, account for only 17 per cent. By comparison, in all of England the total sales by authorized electric services are made up of 35 per cent for domestic purposes and 65 per cent for power and traction. The use of cookers in rural areas has proved to be particularly popular, and the two-part tariff has been adopted by 66 per cent of the consumers.

At the end of the fourth year, 678 miles of mains and 741 pole-type transformers had been provided to supply 7,508 consumers. This is roughly equivalent to one mile of distribution main and one transformer for every ten consumers, a striking indication of the scattered nature of the population. From published records it appears that over the whole country the average figure is 62 consumers per mile of main. The proportion of high-voltage mains, namely 515 miles in a total of 678 miles, shows that the distribution is largely carried out at 11,000 volts. Among the entire 7,508 consumers 2,526 cookers were in use, or by about one consumer out of every three. Eliminating the business premises, it appears probable that a proportion of one cooker to every two domestic consumers soon will be reached. Although the number of consumers has increased rapidly from year to year, the domestic energy use per consumer also has increased rapidly from 530 units in the first year to 960 units in the fifth year.

Conclusions

The author believes that a budgetary policy, in which deficiencies or narrow margins of profit in the early years of a venture in rural electrification are balanced against the increasing returns of later years, can be adopted safely, since the ultimate financial success of rural electrification is reasonably assured. A ten-year basis is suggested; and although rural schemes cannot be expected to provide for both interest and depreciation from their inception, in general a self-supporting basis will be reached by the end of five years.

Minimum capital cost of construction and rapid expansion of revenue are essential for the success of rural electrification. Underground cables never should be used except in circumstances prohibiting the use of overhead lines or surface wiring.

To promote the development of revenue, adequate apparatus-rental and assisted-wiring plans are essential. Rental plans always should include free repair and maintenance of apparatus. Assisted-wiring schemes can be undertaken confidently on a large scale, since, unlike rental plans they involve neither obsolescence nor material maintenance during the period of purchase. In all such plans the use of simple agreements not burdened by restrictive clauses, and the elimination of deterrents such as initial payments, have a strong stimulating effect on development.

Special prominence should be given to the two-part methods of charge in all printed tariffs and publicity matter and in all correspondence and canvassing. The flat rates should be regarded as alternatives, and be kept relatively high so as further to encourage the adoption of the two-part tariffs, the primary charge of which should be kept fairly high so as to permit the secondary rate being relatively low.

Wherever possible, service connections should be made free. A service charge, however trivial, is a perpetual source of annoyance to prospective customers, and may have a retarding effect on development. A method of guaranteed revenue is preferable to that of capital contributions, since the consumer usually will arrange to make corresponding use of the supply; nevertheless, development of a rural area should be possible without requiring any capital contribution or guaranteed revenue.

The average revenue obtainable from domestic consumers in rural areas is higher than the corresponding revenue obtainable in city and urban areas, and, in consequence, electrification in rural areas may be expected ultimately to be as remunerative as that in urban areas.

News
Of Institute and Related Activities

54th Annual Summer Convention First To Be Held in Washington, D. C.

THE annual summer convention held June 20–24 at the Mayflower Hotel in Washington, D. C., 54th such meeting to be held by the Institute, was the first to be held in the nation's capital city. For what is now District 2, this was the eighth summer convention, others having been held as follows: Philadelphia, Pa., 1884, 1894, 1900; Deer Park, Md., 1915; Cleveland, Ohio, 1916, 1932; White Sulphur Springs, W. Va., 1926.

Attendance figures are given in an accompanying tabulation, and highlights of the convention are reported on this and the following pages.

Annual Business Meeting

Departing from the practice of recent years, the Institute's official annual meeting was held the morning of the second day of the convention rather than the first. This meeting was opened promptly at 9:30 Tuesday morning June 21 in the main ballroom of the Mayflower Hotel by Chairman H. W. Osgood of the general convention committee. A cordial welcome to Washington and an explanation of the various attractive features provided by the convention committee was given by Doctor William McClellan, past president of the Institute (1921–22) and honorary chairman of the general convention committee. For the conduct of the business meeting, President W. H. Harrison took the chair and paid tribute to the summer convention committee for the results of its work.

REPORTS OF THE BOARD OF DIRECTORS AND THE COMMITTEE OF TELLERS

National Secretary H. H. Henline presented a digest of the annual report of the board of directors for the fiscal year ending April 30, 1938, pointing out that the full text of the report would be published and thus available for every member of the Institute (*EE July '38 pages 305–15* inclusive). This report contains information that should be of interest to every active member of the Institute. Among the highlights reflected by Mr. Henline were the following: that the three national conventions and two District meetings held during the year had attracted larger numbers than usual and showed an increase in interest in what the Institute and its various divisions are doing; that three new Sections had been formed, bringing the total number to 65, and that the year's total number of Section meetings was the largest ever reported; that one new Student Branch formed during the year brought the total number of these units up to 120; and that the enrollment had reached a total at the end of the year of about 500 higher than last year; and that 1,671 applications for membership received during the year had resulted in a net membership increase of 770, bringing the total up to 16,078 at the end of the fiscal year.

Details concerning Section and Branch activities for the year 1937–38 may be found in the comprehensive annual report published in the recent June issue of ELECTRICAL ENGINEERING beginning on page 263. Other items concerning Section and Branch activities have been published throughout the year.

Reports of the committee of tellers covering both the election of officers and the amendments to the constitution were published in the recent July issue of ELECTRICAL ENGINEERING on page 303.

TREASURER'S REPORT

National Treasurer W. I. Slichter, professor of electrical engineering, Columbia University, New York, N. Y., verified the condition of Institute accounts as covered in the auditor's statement published as a part of the report of the board of directors. In surveying the Institute's general fiscal position, Treasurer Slichter reported that for the third successive year a favorable balance had enabled the placement of nominal amounts in the reserve capital account, thus providing against future possible unfavorable balances. He reported that reserves consist mostly of bonds, with some stocks, which on May 21 showed a ratio of market value to book value of 87$^1/_3$ per cent, a very favorable record.

PRIZE AWARDS

Prize awards for technical papers presented during 1937 were announced on behalf of the AIEE committee on award of Institute prizes by Dean J. W. Barker of Columbia University, New York, N. Y., in the absence of Chairman H. S. Osborne. This report was published in full beginning on page 262 of the recent June issue of ELECTRICAL ENGINEERING. The initial paper prize for District 2 for 1937 was announced by Vice-President I. Melville Stein as having been awarded to F. I. Morgan of the Pennsylvania Water and Power Company for a paper "An Electric Governor" presented before the Baltimore Section.

At the conclusion of the business session, an address "Municipal Planning in Washington" was delivered by Colonel Dan I. Sultan, engineer commissioner for the District of Columbia, who described the history and development of the capital city.

Lamme Medal for 1937 Presented to Doctor R. E. Doherty

To Doctor R. E. Doherty (A'16, M'27) president of Carnegie Institute of Technology, Pittsburgh, Pa., the tenth AIEE Lamme Gold Medal was presented during the summer convention business session "for his extension of the theory of alternating current machinery, his skill in introducing that theory into practice, and his encouragement of young men to aspire to excellence in this field." President Harrison made the presentation following a discussion of the award and its donor by Chairman N. E. Funk of the Lamme Medal committee, and an outline of the professional attainments and career of the recipient given by A. R. Stevenson, Jr. (A'20, F'37) of Schenectady, N. Y., a former associate of Doctor Doherty's. A biographical sketch of Doctor Doherty was published in the recent March issue of ELECTRICAL ENGINEERING, page 141, and Mr. Stevenson's dissertation is scheduled for inclusion in an early issue.

Established for the encouragement and recognition of "meritorious achievement in the development of electrical apparatus or machinery," the AIEE Lamme Medal is one of three bequests provided in 1924 in the will of Benjamin Garver Lamme.

OTHER BEQUESTS

One of the other bequests was made to Ohio State University, Columbus, which

Table I. Analysis of Attendance at 1938 Summer Convention, Washington, D. C.

Classification	Dist. 1	Dist. 2	Dist. 3	Dist. 4	Dist. 5	Dist. 6	Dist. 7	Dist. 8	Dist. 9	Dist. 10	Foreign	Totals
Members	71	297	94	35	50	7	20	5	7	7	3	596
Enrolled Students	2	11		1	1							15
Men guests	10	43	10		6		2			2	11	84
Women guests	15	61	16	9	11		9	1	3	3	2	130
Totals	98	412	120	45	68	7	31	6	10	12	16	825

Table II. Summer Convention Attendance During Recent Years

1938	Washington, D. C.	*(2)	825
1937	Milwaukee, Wis.	(5)	1,067
1936	Pasadena, Calif.	(8)	715
1935	Ithaca, N. Y.	(1)	904
1934	Hot Springs, Va.	(4)	351
1933	Chicago, Ill.	(5)	968
1932	Cleveland, Ohio	(2)	1,022
1931	Asheville, N. C.	(4)	525
1930	Toronto, Ont., Canada	(10)	1,110
1929	Swampscott, Mass.	(1)	1,000

* District numbers in parentheses.

recently awarded its current medal "for meritorious achievement in engineering" to Professor Emeritus James E. Boyd, for 28 years chairman of the department of mechanics. The remaining bequest was made to the Society for the Promotion of Engineering Education, which recently announced its current (eleventh) award to R. L. Sackett, dean of the college of engineering at Pennsylvania State College from 1915 to 1937.

Planté Medal to Doctor Vinal

A colorful highlight of the convention was the presentation to Doctor G. W. Vinal, of the Gaston Planté Medal and 4,500-franc prize, previously announced in ELECTRICAL ENGINEERING (Feb. '38, page 85). On behalf of the Société Française des Electriciens, his excellency Count de Saint-Quentin, Ambassador of the French Republic, made the actual presentation before the 290-odd guests assembled for the formal convention banquet held Thursday evening June 23. For the benefit of those assembled, Doctor E. Crittenden (A'19, M'22) assistant director of the U. S. National Bureau of Standards briefly sketched the scope and significance of the work that has been done by Doctor Vinal in the field of international standards and especially in the development of the electric storage battery.

Principal physicist of the U.S. Bureau of Standards since 1929, and chief of the Bureau's section of electrochemistry since 1918, Doctor Vinal has devoted himself principally to electric batteries, including standard cells, dry cells, and storage batteries. Special credit is given to him for improvement in both dry cells and storage batteries to meet rigorous military requirements growing out of the world war. Also, he took an important part in the extensive researches conducted from 1908 to 1917 which established the reliability of the silver voltameter as the primary standard for measurement of electric current in the "International" system of units. He served as the representative of the United States in the co-operative measurements made with the voltameter in Berlin in 1931, and prepared the report on the silver voltameter for the International Electrical Congress in Paris in 1932.

The Gaston Planté medal was established June 10, 1935 by the Societé Française des Electriciens "to honor the memory of the illustrious philosopher who added to the progress of an industry born of his invention." "To any person, French or foreigner, who, by his works of a scientific or technical nature, will bring an important contribution to the industry of electric accumulators, electric piles, or electrochemistry in general," the silver-gilt medal is intended to be awarded every three years accompanied by a prize of about 4,000 francs. The commission of award is made up of officers of the Societé and officers and members of the committee of celebration of the centenary of Gaston Planté. Regulations provide that electrotechnical societies of each country may propose a candidate for the choice of the commission. For the initial award of the Planté medal the American Institute of Electrical Engineers successfully proposed the name of its distinguished member, Doctor George W. Vinal.

C. C. Chesney Elected to Honorary Membership

As announced in the current July issue of ELECTRICAL ENGINEERING, Past President Cummings C. Chesney (A'94, M'99, F'13) was elected this spring to honorary membership in the Institute. Formal announcement of this fact was made during the business session of the recent summer convention by President W. H. Harrison who presented a certificate to Mr. Chesney. In 1921 Mr. Chesney received the Institute's Edison Medal "for early developments in alternating-current transmission." Active in the electrical industry for 50 years and in Institute affairs for 44 years, Mr. Chesney becomes the tenth living Honorary Member, and the 34th person so to be honored by the Institute in its 54 years of existence. The other living Honorary Members are: B. J. Arnold ('37); A. E. Blondel ('12); Alex Dow ('37); W. L. Emmet ('33); Herbert Hoover ('29); A. E. Kennelly ('33); R. A. Millikan ('33); C. F. Scott ('29); M. Shibusawa ('29).

The grade of Honorary Member is the highest in the AIEE, and is provided for in Sections 8 and 9 of the Institute's Constitution, which stipulate that "Honorary Members may be chosen from among those who have rendered acknowledged eminent service to electrical engineering or its allied sciences." Proposal by at least 10 members and subsequent to unanimous affirmative action of the board of directors is required for election. The board elected Mr. Chesney at its May 26 meeting.

Other Convention Features

Technical and general sessions and entertainment features were run off essentially in conformity with the schedules as published in the news section of the June issue of ELECTRICAL ENGINEERING. The 48 technical papers accommodated by the 10 technical sessions ultimately will be published in ELECTRICAL ENGINEERING or TRANSACTIONS. Brief reports covering the six technical conferences and of certain technical committee sessions may be found elsewhere in this issue. Of the several special addresses presented, the president's annual message was published in the July issue beginning on page 279, and the address by Dr. Gregg on weather forecasting is scheduled for inclusion in an early issue.

The convention meeting of the board of directors is reported elsewhere in this issue. Following the board meeting Thursday afternoon, June 23, a special conference was attended by vice-presidents, District secretaries, and counselor-delegates. Institute operating problems were discussed, but no actions were taken.

SPORTS EVENTS

National competition among Institute members on the basis of match play and handicap for the Mershon trophy was won by T. O. Rudd (A'26) of New York, N. Y., with J. H. Irwin (A'20) Washington, D. C. as runner-up; handicap in each case, five. Mr. Rudd thus becomes the third to have his name engraved upon the present trophy, which is the third cup donated by Past President Ralph Mershon. This trophy remains on display at Institute headquarters.

The Lee trophy, presented in 1932 by the late Past President W. S. Lee is awarded each year to the player having the lowest net score for 36 holes, and must be won

Summer Convention

At the head table from left to right: National Secretary H. H. Henline, Past President P. M. Lincoln; C. A. Robinson, vice-chairman, general convention committee; Doctor E. C. Crittenden, assistant director, National Bureau of Standards; Doctor G. W. Vinal, Gaston Plante Medalist; His Excellency, Count de Saint-Quentin, ambassa-

twice by the same player for permanent possession. As the result of the 36-hole medal play in Washington, T. A. O'Halloran (A'36) of Washington, D. C. with a net score of 138 became the seventh person to win a leg on the cup and the privilege of having his name engraved thereon; runner-up was F. W. Altrup (A'32) of Washington, D. C.; handicaps respectively 24 and 19. In the initial rounds, J. H. Irwin and F. W. Altrup were tied for second place with a score of 147.

By virtue of winning the men's tennis singles, C. B. Oler (M'35) became the fourth to have his name engraved upon the present Mershon trophy which was donated in 1935 by Past President Mershon; runner-up was J. d'Harcourt (A'22) of Paris, France. Men's doubles were won by A. O. White (A'22, M'34) and L. W. Bates (A'04) of Washington, D. C., with S. B. Crary (A'31, M'37) of Schenectady, N. Y., and R. B. Hubbard (A'20, M'28) of Denver, Col., as runners-up. Mixed tennis doubles were won by Mr. and Mrs. A. O. White, with Mr. and Mrs. D. C. Prince of Philadelphia, Pa., as runners-up. Women's singles competition was won by Mrs. A. O. White, with Mme. J. d'Harcourt of Paris, France, as runner-up.

In the table tennis competition, the winner among the women was Mrs. F. B. Crider of Washington, D. C.; winner of the men's competition was Professor W. L. Everitt (A'25, F'36) of Columbus, O. Women's putting contest was won by Mrs. C. A. Corney, Boston, Mass., with second and third places going respectively to Mrs. R. K. Lane, Tulsa, Okla., and Mrs. C. Birdwell, Louisville, Ky.

All sports competitions were held at the Congressional Country Club. Officially starting in the various tournaments were: 24 players in the Lee and Mershon golf event; 16 women in the putting contest; 8 men and 4 women in the tennis singles; 4 teams in the mens tennis doubles, and 4 teams in mixed doubles. A choice variety of valuable prizes was distributed by the local committee.

Future AIEE Meetings

Pacific Coast Convention
Portland, Ore., August 9–12, 1938

Southern District Meeting
Miami, Fla., November 28–30, 1938

Winter Convention
New York, N. Y., January 23–27, 1939

South West District Meeting
Houston, Texas, Spring, 1939

North Eastern District Meeting
Springfield, Mass., May 1939

Summer and Pacific Coast Convention (combined)
San Francisco, Calif., June 26–30, 1939

Middle Eastern District Meeting
Scranton, Pa., October 11–13, 1939

Great Lakes District Meeting
Minneapolis, Minn., Fall, 1939

Annual Conference of Officers, Delegates, and Members Held at Washington, D. C.

UNDER joint sponsorship of the AIEE committees on Sections and Student Branches, the annual conference of officers, delegates, and members was held Monday, June 20, 1938 at Washington, D. C., on the first day of the summer convention. Sessions were held in both morning and afternoon, and were attended by delegates from 58 of the Institute's 65 Sections, 6 of the 10 District secretaries, counselor delegates from 8 of the 9 Districts in which committees on student activities had been organized, and many other local and national officers of the Institute and members interested in Institute activities. W. H. Timbie, chairman of the Sections committee, presided. Topics discussed were as follows:

10:00 a.m.

1. Opening remarks, including comments on Section representation on national committees—Chairman W. H. Timbie.
2. Ways and means of encouraging the preparation and submission of papers suitable for prize awards—I. Melville Stein.
3. National membership reinstatement and transfer policies—Harold Goodwin, Jr.
4. Contacts with preparatory-school guidance teachers and prospective engineering students—M. S. Coover.
5. Miscellaneous Section problems.

2:00 p.m.

6. How can Sections contribute to and become acquainted with the work of the A.E.C.—William McClellan.
7. Symposium on registration of engineers.
   (*a*) History and philosophy of licensing—L. W. W. Morrow.
   (*b*) Model law—C. R. Beardsley.
   (*c*) General discussion.
8. Miscellaneous Section problems.

Following the discussion of items 1 and 2 in the morning session, the conference was divided into two parts, the Sections delegates and Student Branch counselors holding separate sessions. Under "Miscellaneous Section problems," the following topics were discussed: term of office of Section officers; revised TRANSACTIONS format; technical sessions for Section meetings; publication policy with respect to Section papers; and Section co-operation.

Opportunity was provided for general discussion from the floor on all subjects. These discussions constituted an interchange of ideas among the Section delegates and other interested officers and members that proved mutually helpful. At the conclusion of the afternoon session, Chairman Timbie introduced President-Elect John C. Parker who spoke briefly.

PHILOSOPHY OF REGISTRATION DISCUSSED BY L. W. W. MORROW

Thirty-nine states now have laws requiring the registration and licensing of engineers, and other states have active committees advocating the passage of such laws, according to L. W. W. Morrow (A'13, F'25) who addressed the conference on the history and philosophy of registration. Some 47,000 engineers have been licensed under these laws. Mr. Morrow first traced the licensing movement from its early beginning in the West to its present status.

"The philosophy of the licensing movement as such" he said, "is to give a professional and legal status whereby the profession itself, in return for service rendered, can

Formal Dinner

dor of the French Republic; Doctor W. H. Harrison, president AIEE; Doctor William McClellan, past president AIEE; Doctor J. C. Parker, president-elect AIEE; Past President H. P. Charlesworth; Past President A. M. MacCutcheon; General Convention Chairman H. W. Osgood, whose committee did a thorough job

Photo by Rideout

Membership—

Members of the Institute:

The past two years of my AIEE activities have been made most pleasant by the many close associations with you as chairman of your membership committee.

The committee is pleased to report an increase in Institute membership, during these two years, from 14,600 to 16,078, or about ten per cent of the 1936 total.

This is a committee that deserves and has received unified help from the whole membership. Though individually you may not realize it, collectively your own boosting has been the major force accounting for our steady growth. The field is still fertile and I hope you will continue your good efforts after the new chairman takes over this month.

With sincere thanks and appreciation to you and with best wishes to my successor and his committee, I sign finally as,

G. A. Kositzky

Chairman,
National Membership Committee

fix its standards, can fix its qualifications, can fix its rules of conduct. . . . . . it offers to us an opportunity for advancement we have not had heretofore. I think if we neglect participation in this movement, it is going to get into unwise hands. I think if we neglect it, we are going to see our young engineers graduating from college today drift off into a unionization movement that has hazards. . . . .My plea is that you can establish the profession in a practical manner through this licensing and registration movement if the engineers themselves get back of it.

Status of Model Law
Reported by C. R. Beardsley

Speaking as chairman of a special committee to draft a model law, C. R. Beardsley (A'08, F'30) briefly reviewed the position of the AIEE with respect to licensing legislation stating that: "There are continually coming before the legislatures amendments and modifications of the laws, and these in general are tending toward a much greater restriction, a much more rigid requirement. They go beyond the minimum requirement which should be made in order that all engineers be licensed."

After briefly reviewing the various efforts to establish a model law that have been made from time to time by various groups, Mr. Beardsley quoted the following items from the code of principles that had been prepared as a basis for drafting the AIEE model law:

1. Legislation of this type is enactable only for the public benefit and should be limited to that objective. Any benefit to the profession should be incidental.

2. Legislation is prefaced with statement of purpose. The purpose of enactments on licensing engineers usually reads "in order to safeguard life, health, and property." Enactments should avoid embodying provisions beyond the stated purposes and for unnamed ulterior objectives because such provisions would depart from the basic principle of truth which is the keystone of ethical engineering practice.

3. Public benefit will be protected in the maximum possible degree if it is assured that those who offer engineering services to the public are competent to render the service contemplated. Legislation can assure that certain minimum standards of competence exist and can provide for enforcement. It cannot attempt more than this. The public must determine for itself any necessity for competence in excess of the minima. Higher development of engineering competence beyond these minimum requirements continues to be the objective of engineering educational institutions and engineering societies, and its attainment is assured without legal requirement.

4. To assure these conditions it is not necessary that all engineers be subject to legislation, but only those who offer service for hire, or are public employees.

"We have taken the position," he continued, "that we should not attempt to work into a law a benefit to the profession which is not stated in objectives of the law. I don't think we will get very far with the legislatures in the enactment of new laws if we say we want this law so written that the engineering profession will have its rates of compensation raised, or be put in a better position."

Mr. Beardsley reported that the proposed model law that has been drawn up by the committee, based upon these principles, is now undergoing legal scrutiny.

Following the addresses by Messrs. Morrow and Beardsley, the whole subject of registration was discussed at some length. Several delegates reported that their Sections had been active in preventing the passage of improper licensing legislation and also in assisting in drafting or revising state registration laws. Mr. Beardsley asked that the committee be given the benefit of any additional comments or suggestions that members may wish to offer.

Term of Section Officers

Among the several Sections problems discussed at the conference, was a proposal to change the date on which Section officers assume their duties. Many delegates reported that their Sections had found it advantageous to begin their administrative years on dates other than January 1 or August 1, as specified in the AIEE by-laws. Either June 1 or July 1 appeared to be preferred by several Sections.

The subject was discussed at some length, but a motion to pass a resolution that the by-law be changed was tabled. Subsequently, however, Chairman Timbie of the Sections committee appointed a special subcommittee to consider the matter. As a result, the Sections committee submitted the following recommendation to the board of directors at its June 23 meeting:

1. That the dates for the beginning of Section administrative years be deleted from section 43 of the by-laws so that each Section may begin its administrative year at the time which is best suited to local conditions.

2. That section 43 of the by-laws be modified by deleting the second sentence, after which this section of the by-laws would read as follows:

> "The chairman and secretary of each Section shall be elected for the term of one year, beginning upon the date specified in the by-laws of the Section. The by-laws of the Section shall determine whether or not these officers shall be eligible for re-election."

The board approved the recommendation and voted that the prescribed procedure be followed for the revision of section 43 of the by-laws as recommended (see report of board of directors meeting elsewhere in this issue).

Section Papers and Discussions

Another Section problem discussed at the conference related to the publication policy with respect to Section papers and discussions. Section 45 of the AIEE by-laws covering this point reads:

> Papers and discussions presented before a Section or Branch shall be the property of the Institute, and may be published only on authorization of the Publication Committee. Where publication in Transactions of Section or Branch papers by non-members of the Institute is involved, approvals shall be obtained in accordance with Section 95 of the By-Laws.

Several delegates reported that a literal interpretation and enforcement of this by-law would seriously hamper them in their effort to obtain speakers at Section meetings because some speakers prefer to retain publication control of their material. Chairman I. Melville Stein of the publication committee called attention to the fact that the by-law under discussion was one of long standing, that its interpretation in recent years had been liberal rather than strict. He mentioned also the membership demand for the publication of Section papers in

ELECTRICAL ENGINEERING and the efforts of the publication committee to supply that demand. However, he drew a distinction between a Section "paper" and "talk." "Where speakers speak from cards or from no notes at all," he said, "there is no paper; it is just a talk, and the by-laws don't apply." Where Section meeting speakers do prepare manuscripts he said that arrangements sometimes are made for simultaneous publication in ELECTRICAL ENGINEERING and another publication.

As the outcome of the discussion on this subject, a motion was passed authorizing the appointment of a committee to investigate the matter. Subsequently the following were appointed: I. Melville Stein, chairman of the publication committee; A. F. Dixon, chairman of the New York Section; R. G. Lorraine, secretary of the Northeastern District.

STUDENT GUIDANCE DISCUSSED

Professor M. S. Coover (A'16, M'32) reported the results of a canvass of AIEE Sections to determine how extensively the pamphlet "Engineering—a Career, a Culture" had been used in promoting student guidance. On the basis of replies from 30 Sections, the average number of booklets distributed per Section appeared to be between 100 and 150 copies; one Section had distributed none while the maximum distributed by any one Section was 700 copies. Some Sections, particularly those in which the membership is concentrated in a rather small geographic area, had made rather effective follow-ups on the distribution of these booklets. In response to the question "Do you consider that the time and expense in preparing the booklet has been justified?" the answer without exception was "yes."

In the general discussion following Professor Coover's remarks, it was pointed out that many vocational-guidance teachers are not sufficiently familiar with engineering to present the subject effectively to the

Table I. Record of Attendance of Section Delegates and Student Branch Counselors at Washington Conference

Section	Delegate Name and Affiliation
Akron	A. O. Austin (A'04, F'25) manufacturing engineer, Barberton, Ohio; Section chairman 1937–38
Alabama	F. R. Maxwell (M'30) professor of electrical engineering, University of Alabama; Section secretary 1937–38
Baltimore	J. H. Lampe (A'20, M'26) associate professor of electrical engineering, Johns Hopkins University; Student Branch Counselor
Boston	J. G. Patterson (A'14, M'21) engineer of transmission and protection. New England Telephone and Telegraph Company; Section chairman 1938–39
Central Indiana	L. E. Beck (A'29, M 37) assistant professor of electrical engineering, Purdue University
Chicago	J. A. Fitts (A'20) Chicago Branch engineer, Electric Storage Battery Company; Section chairman 1938–39
Cincinnati	J. A. Noertker (A'23, M'32) electrical engineer, Cincinnati Street Railway Company; Section chairman 1938–39
Cleveland	W. C. Kalb (A'12, M'15) Carbon Sales Division, National Carbon Company Incorporated; Section chairman 1938–39
Columbus	C. D. Price (A'23, M'30) substation engineer, Columbus and Southern Ohio Electric Company; Section chairman 1937–38
Connecticut	J. A. French (M'22) assistant engineer, Connecticut Light and Power Company; Section chairman 1937–38
Dallas	E. B. Robertson (M'24) sales engineer; Section chairman 1938–39
Denver	N. R. Love (A'25, M'38) chief engineer, Denver Tramway Corporation; Section chairman 1937–38
Detroit-Ann Arbor	D. H. Baker (A'30) transmission and protection engineer, Michigan Bell Telephone Company; Section chairman 1937–38
East-Tennessee	E. E. George (A'20, F'36) superintendent of system operation, Tennessee Electric Power Company; Section chairman 1937–38
Erie	L. S. Cooper (A'29) transmission engineering department, General Electric Company; Section chairman 1937–38
Florida	A. P. Michaels (A'27, M'37) consulting engineer, A. P. Michaels Engineering Firm; Section chairman 1937–38
Fort Wayne	C. S. Allen (A'31, M'37) design engineer, General Electric Company; Section chairman 1937–38
Georgia	J. O'D. Shepherd (A'34) cost studies engineer, Southern Bell Telephone and Telegraph Company, Atlanta
Houston	Seth Evans (M'29) electrical engineer, Hughes Tool Company; Section chairman 1938–39
Iowa	O. A. Brown (A'30) assistant professor of electrical engineering, Iowa State College; Section chairman 1937–38
Ithaca	L. A. Burckmyer, Jr. (A'32) assistant professor of electrical engineering, Cornell University; Section chairman 1937–38
Kansas City	M. M. Boggess (A'23) sales agent, General Electric Company; Section chairman 1937–38
Lehigh Valley	E. F. Weaver (A'26) superintendent, Pennsylvania Power and Light Company; Section chairman 1938–39
Los Angeles	W. F. Grimes (A'19, M'27) manager, Radio Interference Engineering Bureau; Section chairman 1937–38
Louisville	F. W. Russell (A'26) electrical construction engineer, Louisville Gas and Electric Company; Section chairman 1937–38
Lynn	E. H. Raddin (A'36) chief engineer, Champion Lamp Works; Section chairman 1938–39
Madison	E. D. Ayres (A'26, M'31) associate professor of engineering economics, University of Wisconsin; Section chairman 1937–38
Memphis	J. H. Tole (A'30) sales engineer, Westinghouse Electric & Manufacturing Company; Section chairman 1937–38
Milwaukee	L. H. Hill (A'22, F'38) engineer in charge, transformer division, Allis-Chalmers Manufacturing Company; Section chairman 1937–38
Minnesota	C. H. Nelson (A'21) appraisal engineer, Minnesota Tax Commission; Section vice-chairman 1937–38
Muscle Shoals	B. B. Bessesen (A'17, M'27) electrical engineer, superintendent of power, Tennessee Valley Authority; Section chairman 1937–38
Nebraska	F. W. Norris (A'19, M'26) associate professor of electrical engineering, University of Nebraska; Section chairman 1937–38
New Orleans	L. T. Frantz (M'19) electrical engineer, Sewerage and Water Board of New Orleans; Section chairman 1938–39
New York	A. F. Dixon (A'14, F'26) director of systems development, Bell Telephone Laboratories, Incorporated; Section chairman 1937–38
Niagara-Frontier	E. J. Rahill (A'32) division transmission engineer, New York Telephone Company; Section chairman 1938–39
North Carolina	M. E. Lake (A'23, M'31) power sales engineer, Duke Power Company; Section chairman 1937–38
Oklahoma City	G. I. Page (A'34) operating engineer, Southwestern Light and Power Company; Section chairman 1938–39
Pittsfield	L. Wetherill (A'27, M'37) assistant engineer, high-voltage bushing engineering department, General Electric Company; Section chairman 1938–39
Portland	C. B. Carpenter (A'23, M'34) engineer, Pacific Telephone and Telegraph Company; Section chairman 1938–39
Rochester	B. M. Werly (A'25, M'34) electrical engineer, Eastman Kodak Company; Section chairman 1937–38
St. Louis	L. O. Campbell (A'20, M'29) assistant to engineer, General Electric Company; Section chairman 1938–39
San Antonio	O. W. Sommers (A'30) engineering department, San Antonio Public Service Company; Section chairman 1938–39
San Francisco	F. S. Benson (A'28, M'36) assistant electrical engineer, Pacific Gas and Electric Company; Section chairman 1938–39
Schenectady	C. E. Kilbourne (A'29, M'37) designing engineer, motor generator engineering department, General Electric Company; Section chairman 1938–39
Seattle	R. E. Kistler (A'17, M'30) transmission and protection engineer, Pacific Telephone and Telegraph Company; Section chairman 1938–39
Sharon	H. S. Smith (A'23, M'30) section engineer. Westinghouse Electric & Manufacturing Company; Section chairman 1937–38
Spokane	H. L. Vincent (A'25) salesman, Westinghouse Electric Supply Company
Springfield	F. R. Longley (A'25) system planning engineer, Western Massachusetts Companies; Section chairman 1937–38
Syracuse	W. H. Lawrence (A'31) assistant power engineer, Central New York Power Corporation; Section chairman 1937–38
Toronto	R. E. Jones (M'26) assistant engineer, Hydroelectric Power Commission of Ontario; Section chairman 1937–38
Tulsa	R. K. Lane (M'37) vice-president in charge of production, Public Service Company of Oklahoma; Section chairman 1937–38
Urbana	C. A. Keener (A'21, M'28) associate professor of electrical engineering, University of Illinois; Section chairman 1937–38
Utah	J. A. McDonald (A'21) superintendent, service shop, General Electric Company; Section chairman 1938–39
Vancouver	F. L. Code (A'27) instructor, Vancouver Technical School
Virginia	W. F. Nimmo (A'30, M'35) general engineering department, Virginia Electric and Power Company; Section chairman 1937–38
Washington	T. R. Tate (M'24, F'35) chief, power resources and requirements division, Federal Power Commission; Section chairman 1938–39
Wichita	R. R. Miner (A'30, M'37) electrical engineer, Kansas Gas and Electric Company; Section chairman 1937–38
Worcester	T. R. Holton (A'26, M'35) electrical engineer in charge of testing, American Steel and Wire Company; Section chairman 1938–39
Chairman, Sections committee	W. H. Timbie (A'10, F'24) professor of electrical engineering, Massachusetts Institute of Technology, Cambridge

Table II. Record of Attendance of District Student Branch Counselor-Delegates

District	Delegate Name and Affiliation
1	E. M. Strong (A'26) associate professor of electrical engineering, Cornell University, Ithaca, N. Y.
2	J. T. Walther (A'19, M'26) professor of electrical engineering, University of Akron, Akron, Ohio
4	E. F. Smith (A'31, M'34) associate professor of electrical engineering, University of Florida, Gainesville, Fla.
5	G. W. Swenson (A'19, F'36) professor and head of electrical engineering dept., Michigan College of Mining & Technology, Houghton, Mich.
6	L. A. Bingham (A'29) assistant professor of electrical engineering, University of Nebraska, Lincoln, Neb.
7	N. F. Rode (A'22, M'32) professor of electrical engineering, A. & M. College of Texas, College Station, Texas
8	H. H. Skilling (A'28, M'34) assistant professor of electrical engineering, Stanford University, Calif.
9	A. L. Taylor (M'28) professor of electrical engineering, University of Utah, Salt Lake City, Utah

Chairman, Committee on Student Branches—F. Ellis Johnson (A'13, F'31) dean of College of Engineering, University of Missouri, Columbia, Mo.

students in high schools and preparatory schools. It was considered important to extend guidance programs not only to the students themselves but also to the vocational-guidance teachers, either through the teachers colleges where those teachers receive their training, or through direct contact with the teachers. The importance of discouraging those students who are not fitted for engineering from taking engineering courses, as well as encouraging properly qualified students, was emphasized.

New Transactions Format Announced

Chairman I. Melville Stein of the AIEE publication committee announced during the conference that beginning with the September issue of Electrical Engineering the Transactions Section will appear in a three-column instead of the present two-column format. He pointed out that the present size of type used in the discussions is smaller than is recommended for easy reading with the length of line used in the two-column format. With the three-column format, the length of line will be reduced by about one-third, which should improve the readability of the discussions considerably; also, the narrower column width will allow a slightly smaller text type to be used for the papers without impairing readability, thus effecting some space economy. Another advantage of the three-column format cited by Mr. Stein is that some of the waste space now appearing around formulas and illustrations and at the ends of papers will be eliminated. He asked that the members look over the new format when it appears in the September issue and forward to the publication committee any comments they may wish to offer.

Relation of AIEE Sections to AEC

Under the title "How Can Sections Contribute to and Become Acquainted With the Work of the American Engineering Council," Past President William McClellan, who currently is president of AEC, presented briefly a picture of what Council is, the situation that led to its organization, and some of its present activities. He pointed out that Council's primary function is to serve as the Washington "embassy" of the engineering profession.

"You can help," Doctor McClellan told the delegates, "first of all by understanding the need in this profession of ours for . . . a united force; secondly how it is organized, what it does, particularly this ambassadorial function here in Washington. . . . " Specifically, he urged the Section secretaries to "get a copy of our News Letter, our bulletin which comes out every month. Pick out . . . those things that may be interesting to you and present them at your meeting; devote a little bit of time at those meetings in discussing those points. Perhaps somebody will want to make a suggestion to us about them. In other words, realize what the American Engineering Council is; make use of the information that is sent out to tell you what it is doing; make that information of practical value by discussing it somewhat, and the most practical form of discussion, of course, is constructive suggestions as to what further we can do."

Counselor-Delegate Session

With Chairman F. Ellis Johnson of the committee on Student Branches presiding, a group of counselor-delegates and others interested in that phase of Institute work adjourned from the general conference session early Monday forenoon, spending the remainder of the day including an evening dinner session in discussing various problems related to Student Branch activity and other topics of mutual interest. Chairman Johnson reported that he had sent questionnaires to the chairman and the counselor of each of the 120 Student Branches, and that to date returns had been received from 53 counselors and 34 student chairmen. An informal discussion ensued concerning some of the points raised; full analysis of the returns had not been completed.

Table III. Record of Attendance of District Secretaries

District	Delegate Name and Affiliation
1	R. G. Lorraine (A'29, M'36) application engineer, central station department, General Electric Company, Schenectady, N. Y.
4	Stanley Warth (A'28, M'36) division transmission engineer, Southern Bell Telephone and Telegraph Company, Louisville, Ky.
5	A. G. Dewars (A'17, M'27) system planning engineer, Northern States Power Co., Minneapolis, Minn.
6	H. F. McPhail (A'19, M'27) assistant chief electrical engineer, U.S. Bureau of Reclamation, Denver, Colo.
7	L. C. Starbird (A'32, M'35) transmission and protection engineer, Southwestern Bell Telephone Company, Dallas, Tex.
8	A. M. Bohnert (A'12, M'26) district sales manager, Ohio Brass Company, San Francisco, Calif.

Out of the day's discussions, came the following recommendations concerning Institute policy and procedure with respect to Student Branches:

1. That where local memberships are provided, such membership by upper classmen who are not Enrolled Students in the Institute be discouraged.
2. That the committee on Student Branches be requested to recommend to Student Branches where local members are provided, that no such local members be permitted to vote in electing officers or in determining Student Branch policies.
3. That the committee on Student Branches be requested to canvass all District and sub-District groups of Branches to determine the rules and regulations now applying in the conduct of student paper competitions, and report to all Branch counselors.
4. That it be recommended that in the annual report of Branch activities which is published, those institutions requiring attendance at Branch meetings be identified.

AIEE Directors Meet During Summer Convention

The regular meeting of the board of directors of the American Institute of Electrical Engineers was held at the Mayflower Hotel, Washington, D. C., on Thursday, June 23, 1938, during the annual summer convention of the Institute.

Present: *President*—W. H. Harrison, New York, N. Y. *Past Presidents*—A. M. MacCutcheon, Cleveland, Ohio; J. B. Whitehead, Baltimore, Md. *Vice-Presidents*—O. B. Blackwell, New York, N. Y.; L. T. Blaisdell, Dallas, Tex.; M. J. McHenry, Toronto, Ont.; I. Melville Stein, Philadelphia, Pa.; A. C. Stevens, Schenectady, N. Y.; Edwin D. Wood, Louisville, Ky. *Directors*—C. R. Beardsley, F. Malcolm Farmer, and C. R. Jones, New York, N. Y.; N. E. Funk, Philadelphia, Pa.; H. B. Gear and F. H. Lane, Chicago, Ill.; F. Ellis Johnson, Columbia, Mo.; W. B. Kouwenhoven, Baltimore, Md.; K. B. McEachron, Pittsfield, Mass.; R. W. Sorensen, Pasadena, Calif. *National Treasurer*—W. I. Slichter, New York, N. Y. *National Secretary*—H. H. Henline, New York, N. Y. By invitation: *Past Presidents*—H. P. Charlesworth and F. B. Jewett, New York, N. Y.; P. M. Lincoln, Ithaca, N. Y.; William McClellan, Washington, D. C. *Officers-Elect*—John C. Parker, New York, N. Y.; Chester L. Dawes, Cambridge, Mass.; and Leland R. Mapes, Chicago, Ill.

Minutes were approved of the meeting of the board of directors held on May 26, 1938.

A report of a meeting of the board of examiners held on June 15, 1938, was presented and approved. Upon recommendation of the board of examiners, the following actions were taken: 6 applicants were transferred to the grade of Fellow; 15 applicants were transferred and 7 were elected to the grade of Member; 80 applicants were elected to the grade of Associate; 53 Students were enrolled.

Expenditures in June, amounting to $20,552.71, were reported by the chairman of the finance committee and approved by the board.

Approval was given to the dates and location, October 11–13, Scranton, Pa., for the previously authorized Middle Eastern District meeting to be held in 1939.

Professor W. J. Miller was appointed a

representative of the Institute on the delegatory committee for Region IV in connection with the program of the Engineers' Council for Professional Development in the accrediting of engineering curricula, which is being conducted by its committee on engineering schools.

Upon request of the Detroit-Ann Arbor Section, and recommendation of the Sections committee, the board authorized a change in name of that Section to "Michigan Section," as the territory of the Section had expanded and a considerable number of its members reside in other communities in the state.

The board approved in principle a recommendation of the Sections committee "that the dates for the beginning of Section administrative years be deleted from Section 43 of the By-laws so that each Section may begin its administrative year at the time which is best suited to local conditions," and directed that the prescribed procedure be followed for revising Section 43 of the By-laws accordingly.

The members of the board were unanimous in an expression of appreciation of the arrangements that had been made for the 1938 summer convention.

Other matters were discussed, reference to which may be found in this or future issues of ELECTRICAL ENGINEERING.

Reports of Five Technical Conferences Held During the Summer Convention

AS A MEANS of stimulating a direct, informal interchange of thoughts on subjects of a somewhat specialized nature, five technical conferences were held during the AIEE 1938 summer convention. Brief reports of those conferences are presented here. These reports were prepared by the conference chairman, or from notes furnished by them.

Definitions

By Michel G. Malti, Chairman

The technical conference on definitions, covering several sections of the fundamental definitions (group .05) was attended by over 30 members. The chairman outlined the purpose of the conference by stating that the committee on basic sciences is sponsoring this series of conferences on definitions in an effort to help subcommittee 1 of committee 42 [American Standards Association sectional committee on definitions] in framing better definitions. He also asserted that this work is an integral part of the functions of the committee on basic sciences and in fact of all technical committees.

Written discussions were prepared by the following:

A. Boyajian (A'18, F'26), General Electric Company, Pittsfield, Mass.

M. G. Malti (M'34), Cornell University, Ithaca, N. Y.

K. W. Miller (A'23, M'29), Utilities Research Commission, Chicago, Ill.

S. A. Schelkunoff (M'34), Bell Telephone Laboratories, New York, N. Y.

Ernst Weber (A'31, F'34), Polytechnic Institute of Brooklyn, Brooklyn, N. Y.

Following each written discussion the meeting was open for general discussion. This was extremely lively. The interest displayed was excelled only by the friendliness and harmony which prevailed throughout the conference.

Doctor H. L. Curtis (A'21, F'26), of the National Bureau of Standards, Washington, D. C., chairman of subcommittee 1 of committee 42, laid before the conference a few definitions which, he stated, had caused considerable discussion by his subcommittees. Several members commented on these definitions.

It is my belief that this series of conferences on definitions has been extremely helpful in that:

a. They have stimulated general interest, on the part of the Institute membership as a whole, in an important phase of Institute activity which has heretofore been handled exclusively by committees.

b. They have emphasized the importance of accurate, exact, and consistent definitions. This is particularly essential in the case of engineering terms not only technically but also financially. In a law suit, thousands of dollars might change hands because a certain term is defined in a certain way.

The work of the subcommittee on definitions of the committee on basic sciences is by no means finished. In fact it has just begun. It will take a series of several technical conferences to complete this work. The chairman is in favor of having such technical conferences scheduled for all future national conventions until the work has been completed. At the termination of this work a report will be prepared and placed in the hands of subcommittee 1 of committee 42. This will be the report of the committee on basic sciences regarding definitions which fall within its sphere of activity.

Electrical Machinery

By J. L. Hamilton, Chairman

The conference discussed three subjects, as follows:

1. The technical program for the January 1939 meeting of AIEE in so far as the electrical machinery committee is concerned was discussed.

It was generally agreed that practically the entire session be devoted to the study of temperature limits of insulation and the basis of rating of electrical machinery.

The technical program committee and the standards committee of the AIEE have approved this program and the writer has been requested to appoint a special committee to arrange for the program and to solicit representative and authoritative papers on this subject. This committee is being formed and will be announced soon.

2. It has been suggested that the electrical machinery committee consider the editing and publishing of a book which would include pertinent AIEE papers which have been presented during the last several years.

Membership—

Dear Institute Member:

These are the "dog days" of summer, the vacation period of the industry, and quite naturally Institute activities are at low ebb. New executive officers however, are taking up responsibilities and are preparing plans and programs for a year of still greater success.

Now is the time to check over the list of your friends and associates and consider which ones among them (especially among the younger men) should prepare themselves for advancement and increased responsibilities. If you know such men, speak to them today about membership. Their applications should be handed in at once, if they are to have the advantages of participation in their Section activities, commencing in a few weeks.

Yours very truly,

A. B. Cooper

Vice Chairman,
National Membership Committee

A membership proposal form appears on page 14 of the advertising section of this issue

Some members of the electrical machinery committee are of the opinion that a good bibliography of pertinent articles would be satisfactory.

After considerable discussion, it was generally concluded that compiling and editing of a book would entail a large amount of work and there would be considerable question as to whether the value of such a book would warrant the necessary work and expense.

It was also, felt that the engineering service organizations very satisfactorily cover the entire field of engineering, including electrical machinery, and that we should not endeavor to duplicate any phase of this work.

It was, therefore, agreed that the matter should be given further study to determine later at a general discussion as to whether or not any specific plans should be developed by the electrical machinery committee.

3. Some of the members present brought up for consideration the question of closer co-ordination of AIEE and ASA standardization work from the general standpoint and from the specific standpoint of transformer standards.

It was generally agreed desirable for the chairman of the electrical machinery committee to contact the AIEE representatives and the ASA, and convey to them the suggestions brought out in the discussion.

Electronics

By H. M. Turner, Chairman

There was an attendance of over 50 at this technical conference. The main subject for the meeting, the phenomenon of arcback in mercury-vapor rectifiers, was opened by W. C. White (A'23, M'30) who mentioned, among other things, that failures due to arcback are quite infrequent, about one in ten billion cycles.

The nature and various aspects of arcbacks in tank rectifiers, sealed-off pool tubes, as well as in hot-cathode tubes, was considered by the group, which joined actively in the discussion. Theories and observations were offered by those associated with tube design and research. Conditions favorable to the arcback phenomena were outlined but it was pointed out that it was difficult to produce arcbacks at will, which adds to the difficulty of experimental studies. Among the causes mentioned were lack of sufficient emission, dust on anodes, electrode disintegration, local charges accumulating near the plate which persists until the polarity reverses, and residual ionization. Some studies show that the phenomenon in the case of mercury-vapor rectifiers always occurs near the peak of the inverse cycle. Circuit effects and operating results were included by those whose experience or work had been along these lines.

It was very apparent that arcbacks are not only better understood than they were a few years ago, but are no longer a disturbing factor in rectifier operation in the field. There are still differences of opinion, however, as to the explanations of some of the observations and experiences. This fact added interest to the meeting.

Near the close of the meeting there was a discussion of tank rectifiers and hot-cathode rectifiers for large radio transmitter service, with particular reference to differences in practice between Europe and this country.

The meeting lasted more than two hours, and among others who contributed to the discussion were A. W. Hull, General Electric Company, Schenectady, N. Y.; H. E. Mendenhall and S. B. Ingram, Bell Telephone Laboratories, Inc., New York, N. Y.; O. K. Marti (A'21, M'27), Allis-Chalmers Manufacturing Company, Milwaukee, Wis.; B. K. Northrop (A'22) and W. C. Ballard (A'26) of Cornell University, Ithaca, N. Y.; D. E. Marshall (A'27, M'33), Westinghouse Electric and Manufacturing Company, Bloomfield, N. J.; Haraden Pratt (A'15, F'37), Mackay Radio and Telegraph Company, New York, N. Y.; F. E. Terman (A'23, M'34), Stanford University, Calif.; W. L. Everitt (A'25, F'36), The Ohio State University, Columbus; and M. S. Oldacre (A'13), Commonwealth Edison Company, Chicago, Ill.

Machines in Mathematical Analysis

By H. L. Hazen, Chairman

The purpose of this conference was to present before the group a picture of the broad significance of machine methods in the application of mathematical analysis to the many fields at present utilizing mathematical methods. During the past several years the appreciation of the powerful machine methods that can be produced with present techniques for carrying out mathematical processes has grown very rapidly. This applies especially to punched-card machines and to machines for solving ordinary differential equations. It appeared appropriate to the committee on basic sciences to sponsor a conference on the subject of computing and analyzing machines, with a view to bringing together those interested in this field for a presentation of the state of the art and a mutually helpful interchange of ideas.

The program consisted of three papers, a number of invited discussions, and discussion from the floor. The first paper, by Doctor Dederick was somewhat philosophical in nature and attempted to show the inherent and basic reasons why mathematics becomes so laborious in its application to certain practical problems that machine methods become economically essential if these problems are to be solved.

The second paper, by Doctor S. H. Caldwell (A'27), Massachusetts Institute of Technology, Cambridge, recounted briefly the nature and scope of the problems that have been solved by differential analyzers—machines for solving ordinary differential equations with a specific initial or boundary conditions—up to the present, and indicated briefly the field that will be open in the future to machines of this nature having greater effectiveness and scope than the present machines. This record was rather impressive by its size and importance.

The third paper, by Doctor W. J. Eckert, showed broadly how the punched-card equipment commercially developed for accounting and statistical use has been rendered useful in other fields of applied mathematics. Such equipment is of course adapted to performing given arithmetical processes on tremendous quantities of similar data.

The prepared discussions related to certain other types of mathematical machines for solving algebraic polynomials and evaluating parametric integrals, and to certain aspects of machine methods not covered in the three papers.

The field of machines for mathematical analysis is, as stated previously, growing very rapidly at the present time, and it is hoped that a wider realization of the mathematical power of these machines and the scope of their usefulness will result from the conference, as well as the stimulation of new ideas which always occurs when a group interested in a given subject get together.

Power Requirements in Electrochemical and Allied Industries

By F. O. Schnure, Chairman

This conference was attended by a small but appreciative audience. The main address, delivered by J. V. Alfriend, Jr. (A'33), a Federal Power Commission engineer, consisted of a review, on a national scale, of the electrochemical and allied industries, particularly in relation to the amount and methods of power utilization.

Mr. Alfriend's address was extremely interesting, and it is expected that the comprehensive report on these industries which the Federal Power Commission will issue in the near future, will include the data given in his address, so that it will be available for the information of all engineers in this field.

Prepared discussions by M. E. Stone, of the United Engineering and Foundry Company, and Herbert Speight (A'13, M'21) of the Westinghouse Electric and Manufacturing Company, New York, N. Y., followed.

Mr. Stone discussed the present activity in processing steel by electrolytic methods. He spoke of the power required, and the equipment used for cleaning and pickling by electrolytic methods in continuous strip mills. Important future developments in this field being the electrolytic tinning of steel strip, and cladding of steel with metals suitable for corrosion resistance.

Herbert Speight discussed the power requirements in copper refineries, pointing out the necessity in this industry for low cost power at the d-c busbars. He outlined economies which could be obtained by modernization of industrial generating plant, making the best use of waste heat steam in co-ordination with suitable boiler pressures.

Others who took part in the informal discussion included F. O. Schnure (A'23, M'35) of the Bethlehem Steel Company, Sparrows Point, Md., who commented on electrolytic steel processing; Mr. Moss of the Federal Power Commission, and N. R. Stansel (A'03, M'35), of the General Electric Company, Schenectady, N. Y., who were interested in methods of load regulation; O. A. Brown (A'30), of Iowa State College, Ames, who was interested in the possibilities of electric processing of propane gas in the manufacture of carbon black; and C. C. Levy (A'33), of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., who emphasized the wide variety of power requirements, and the high load factor of these industries.

Southern District to Meet in Miami

The Southern District meeting of the AIEE will be held in Miami, Fla., November 28–30, 1938. A program of several technical sessions, sports, trips, and entertainment is in the process of development and the location of the meeting will afford the attendants a few days of winter vacation. Headquarters will be in the Miami Biltmore Hotel at Coral Gables.

Golf, tennis, and fishing may be enjoyed at the Miami Biltmore. Annually, outstanding golf, tennis, and swimming stars gather here with national champions in these sports and their participation in the program of events adds to the entertainment of the guests. The Miami Biltmore is linked by means of a de luxe bus system of free transportation with the Florida Year-Round Clubs, at which those attending the meeting will be the guests of Henry L. Doherty (A'98, F'13), president. These clubs are the Miami Biltmore Country Club, which has two large swimming pools and beaches, an 18-hole golf course, and rows of tennis courts, the Roney Plaza Cabana Sun Club on the Ocean at Miami Beach, and Key Largo Anglers Club in the Florida Keys.

Those making arrangements for the meeting are as follows: A. P. Michaels, *chairman*, Florida Section; Joseph Weil, *secretary*, Florida Section, and the following subcommittee chairmen: W. Austin Smith, *program and papers;* J. B. Hiers, Jr., *finance;* R. Y. Pool, *entertainment;* E. F. Johnson, *hotel and reservation;* P. J. Carlin, *transportation and inspection trips;* J. D. Preston, *attendance and publicity;* and E. F. Smith, *student activities.*

Lightning Arrester Subcommittee Meets

The following report was provided by J. R. North (A'21, M'29), Commonwealth and Southern Corporation, Jackson, Mich., chairman of the subcommittee on lightning arresters of the AIEE committee on protective devices.

The lightning arrester subcommittee held its final meeting of the year during the summer convention (with 11 of 14 members represented) to discuss the progress made on the various projects since the January 1938 meeting.

Considerable interest is being shown throughout the industry in the procedures developed for testing line-type and station-type arresters in the field. Herman Halperin (A'21, M'26), Commonwealth Edison Company, Chicago, Ill., reported the results obtained by numerous companies in testing distribution arresters in accordance with the practices outlined in the report "Testing and Application of Lightning Arresters" (AIEE technical paper 38–43). H. W. Collins (A'22), The Detroit Edison Company, Detroit, Mich., submitted a memorandum outlining the procedure for use in testing particular types of station arresters. It was decided that this work should be continued.

The characteristics of high-voltage line-type arresters have been presented in the committee report "Line-Type Lightning Arrester Performance Data" (AIEE technical paper 38–56). Arrangements were made to continue this work and prepare a similar report covering station type arresters for presentation next year.

A preliminary report of the proposed standards on protector tubes was presented for consideration. This represents the first step toward the formulation of a comprehensive standard covering these devices.

H. R. Stewart (A'26), New England Power Service Company, Boston, Mass., reported on a survey of the industry made during recent months regarding the present Institute lightning arrester standards number 28 and the necessity and desirability of revising them. It was definitely the consensus of opinion that these standards should be revised and it was recommended that this work be undertaken next year.

It is also proposed to study protection problems for specific types of apparatus, including rotating machines, constant-current transformers, induction voltage regulators, short lengths of cables, potheads, and pole-top switches.

In discussing future Institute papers, it was tentatively felt that the subcommittee should sponsor a paper on "Testing Line Type Arresters" by Mr. Halperin and a subcommittee report on protector tubes.

Detroit-Ann Arbor Section Becomes Michigan Section

Upon recommendation of the AIEE Sections committee, the Institute's board of directors has authorized a change in name of the Detroit-Ann Arbor Section to "Michigan Section," but no change in Section territory will be involved.

The Detroit-Ann Arbor Section was organized January 13, 1911. Newly elected officers of the Michigan Section for the term 1938–39 are: *chairman,* R. E. Greene (A'26) senior engineer in the engineering division, The Detroit Edison Company; *secretary,* W. G. Knickerbocker (A'20, M'30) assistant superintendent of meters, The Detroit Edison Company.

CIGRE Representatives Visiting U.S. Industries

A party of distinguished foreign visitors including 12 engineers and others constituting an official delegation of the International Congress of Large High Tension Systems (Conference Internationale des Grands Reseaux Electriques—called CIGRE for short), entered the United States in time to attend the AIEE summer convention in Washington, D. C. June 20–24 inclusive, and since has been touring the country visiting various electrical manufacturing plants and electric power systems. A series of events arranged for this party in Washington during the convention week included a round-table technical conference, an informal reception at the French Embassy, numerous luncheons and inspection trips, and attendance at convention functions.

Participating in the round-table technical conference were the following official CIGRE delegates:

Pierre Prache (A'33), chief engineer, Ateliers de Constructions Electriques de Jeumont, Paris.

Roger Dubusc, chief of the laboratory of measuring apparatus, Fabrication des Compteurs, Paris.

Rene Caizergue, chief of dispatching service, Union d'Electricité, Paris.

Jacques d'Harcourt, director, Société Inter-Paris, Paris.

Thomas Boveri (A'27, M'34), managing director, Brown Boveri and Co., Ltd., Baden, Switzerland.

François Cahen, chief of electric research, Société Alsthom, Paris.

Karel Novak, representative, l'Association des Electriciens Tchecoslovaques, Paris.

Robert Marny, consulting engineer, representing The Association des Electriciens Tchecoslovaques, Paris.

J. Rosen, director, Parsons and Co., Newcastle-on-Tyne, England.

Louis Astier, chief engineer, C.P.D.E., Paris.

Among others comprising the visiting group were:

Marcel Combasson, director, l'Electricité de Marseille, Marseille, France.

Jean Rey du Boissieu, assistant chief engineer of commercial service, l'Est-Lumiere, Paris.

Jean Clopin, commercial director, Société Calor, Lyon, France.

Dominique Denis, chief engineer, Société Parisienne pour les Chemins de Fer et Tramways Electriques, Paris.

Jean Ricard, chief of testing service, l'Union d'Electricité, Paris.

Pierre Delattre, technical director, Cie Nationale du Rhone, Lyon, France.

Fernand Montois, engineer, Société d'Electricité de Paris, Paris.

Max Wurmser, principal engineer, Compagnie Parisienne de Distribution d'Electricité, Paris.

Pierre Gires, chief engineer, The Société d'Electricité de la Region Valenciennes-Anzin, Valenciennes, France.

Arrangements for the visitors were made by a committee organized by Frederic Atwood (M'27) of New York, CIGRE vice president for the United States, with F. A. Allner (A'12, M'14) of Baltimore, Md. as chairman.

ASTM Elects Officers. At the first session of the annual meeting of the American Society for Testing Materials, June 28, 1938, election of the following officers for 1938–39 was announced: *president*—T. G. Delbridge, manager of the research and development department, The Atlantic Refining Company, Philadelphia, Pa.; *vice-president*—W. M. Barr, chief chemical and metallurgical engineer, Union Pacific Railroad company, Omaha, Nebr.; *members of executive committee*—A. T. Goldbeck, engineering director, National Crushed Stone Association, Inc., Washington, D. C., Dean Harvey (A'04, M'14) materials engineer, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., G. E. Hopkins, technical director of the Bigelow-Sanford Carpet Company, Inc., Thompsonville, Conn., Allen Rogers, supervisor of the course in industrial chemical engineering, Pratt Institute, Brooklyn, N. Y., and J. J. Shuman, inspecting engineer, Jones and Laughlin Steel Corporation, Pittsburgh, Pa.

New Requirements for Fellow Grade Now in Effect

On July 21 a revision of the Constitution of the Institute took effect, bearing solely on requirements for the grade of Fellow. With two exceptions, the Fellow grade henceforth is open only to those who have been affiliated with the AIEE in good standing in the grade of Member for a period of at least five years immediately preceding the date of application for transfer. In addition, and with the same two exceptions, applications for Fellow must originate by proposal of five other Fellows or Members. All Fellow applications must comply, exactly as heretofore, with the requirements calling for the submission of detailed professional records and five Fellow references. The two exceptions previously mentioned are contained in clauses "c" and "e" of Section 4, Article II. Provision is made there for the entrance to Fellow grade either directly or through transfer, free of the proposal or previous affiliation requirements, of foreign engineers of standing equivalent to Fellow, as well as those who may have become pre-eminent by virtue of notable original work in electrical science.

To comply with the new requirements of clauses "a," "b," and "d," Fellow applications must be transmitted to headquarters accompanied by communications (letters, or regular forms provided by headquarters) signed by five Fellows or Members proposing the applicants for Fellow. Applications made under clauses "c" and "e" can be either applications for admission to Fellow or transfers from a lower grade, and no proposal requirement is involved.

As pointed out at the time of the submission of the constitutional changes to ballot, the new restrictions on Fellow grade were drawn up in compliance with a strong feeling that had made itself evident over a period of many years—a feeling that the Fellow grade should be in the nature of an award to those engineers who had reached a pre-eminent position through technical accomplishments in the electrical field and who had shown an interest in the welfare of the profession through affiliation with the Institute. At the same time it was realized that there were certain exceptions for which it was desirable to provide; hence clauses "c" and "e."

The changes have received official approval by ballot of the membership (*EE July, p. 303*), and now will be put to test. It is hoped they will accomplish the desired result.

International Testing Congress Proceedings. Proceedings of the 1937 Congress of the International Association for Testing Materials held in London, England, has been issued. The publication includes the more than 200 papers presented and ensuing discussions. Copies, in cloth binding, may be obtained from the secretary of the congress, K. Headlam-Morley, The Iron and Steel Institute, 28 Victoria Street, London, S. W. 1, England, at $7.75 each; this price includes prepayment of postage

Future Meetings of Other Societies

American Association for the Advancement of Science. Winter meeting, December 27–31, Richmond, Va.

American Gas Association. October 10–14, Atlantic City, N. J.

American Physical Society. 223d meeting, November 25–26, Chicago, Ill.

American Society of Mechanical Engineers. Fall meeting, October 5–7, Providence, R. I.

Illuminating Engineering Society. Annual convention, August 29–September 1, Minneapolis, Minn.

International Congress of Applied Mechanics. September 12–16, Cambridge, Mass.

National Electrical Contractors Association. September 12–15, Detroit, Mich.

National Electrical Manufacturers Association. October 24–28, Palmer House, Chicago, Ill.

National Safety Council. October 10–14, Stevens Hotel, Chicago, Ill.

Society of Automotive Engineers. Sectional regional tractor meeting, September 8–9, Minneapolis, Minn.

National regional fuels and lubricants meeting, October 6–7, Tulsa, Okla.

National aircraft production meeting, October 13–15, Los Angeles, Calif.

Letters to the Editor

CONTRIBUTIONS to these columns are invited from Institute members and subscribers. They should be concise and may deal with technical papers, articles published in previous issues, or other subjects of some general interest and professional importance. ELECTRICAL ENGINEERING will endeavor to publish as many letters as possible, but of necessity reserves the right to publish them in whole or in part, or reject them entirely.

ALL letters submitted for consideration should be the original typewritten copy, double spaced. Any illustrations submitted should be in duplicate, one copy to be an inked drawing but without lettering, and other to be lettered. Captions should be furnished for all illustrations.

STATEMENTS in these letters are expressly understood to be made by the writers; publication here in no wise constitutes endorsement or recognition by the American Institute of Electrical Engineers.

Usefulness of Mathematics in Engineering

To the Editor:

Mr. C. J. Holslag's letter in the May 1938 issue of ELECTRICAL ENGINEERING on "Preparation of Manuscripts" calls for comments particularly since he himself invites them.

In the first place it is asserted that the journal publishes as first and foremost school and college papers. A review of ELECTRICAL ENGINEERING for the year 1937 shows that 165 papers were published. Of these, 119 or over 72 per cent came from industry; 42 or over 25 per cent came from colleges, and 4 or about 2.5 per cent were joint papers in which industry and the colleges co-operated. Does this show that college papers are first and foremost?

As to the "mathematical fairy tales," Mr. Holslag might be interested to observe that industry tells them just as tall as the professors do. To convince himself of this fact let him review some of the mathematical papers published by men in the industry such as ELECTRICAL ENGINEERING, volume 56, 1937, pages 27–31, 49–58, 91–100, 333–8, 344–6, etc., etc. Apparently some industries feel that mathematics is useful to them, otherwise they would not allow their men to "waste their time" on these mathematical papers.

Truly nobody is aking Mr. Holslag to believe anything about the electron theory of matter. But there seems to be more fact to it than to the assertions he makes in his letter.

Very truly yours,

M. G. MALTI (M'34)

(Assistant Professor of Electrical Engineering, Cornell University, Ithaca, N. Y.)

To the Editor:

Referring to Mr. Holslag's letter on page 230 of the May 1938 issue, Doctor Pupin once summarized one of his discussions in a sentence that I remember thus: "After you get the physical facts in mind it is easy enough to find the mathematics to prove them." Later he said, if I understood his lowered voice correctly, that he worked out the mathematical theory for his loading coils after he had everything else complete, and did so at all only for sales purposes; he had been obliged to prove the facts to the telephone engineers by mathematics before they would give his unorthodox ideas any consideration. This adds to Holslag's comments on Pupin.

In my opinion, mathematics is a set of tools; and the larger and better the set an engineer has, the better prepared he is to attack any problem that comes to him, other matters being equal. Nevertheless, the prime function of mathematics itself, as distinguished from mathematical training in logical habits of thought, is service. For a tool to give service it must have a workman who knows what he wants to do, as well as knowing how to use the tool. Spending study time in memorizing elaborate mathematical proofs of physical facts and spending recitation and lecture periods in copying differential equations from the board, to my mind, is begging the essential problem. To my knowledge some universities in the East and also in the West are requiring students to do just about these things, instead of giving them clear physical concepts of physical facts, with the result that the ideas of Doctor Michael Pupin, Doctor William Suddards Franklin, and Doctor Carl Hering, to mention only a few of those to whom I have listened in class or in public lecture, are going to the discard. For a decade or more I have asserted with pleasure that the engineering graduate of recent years usually has a better command of English than the average of my day. In contrast, however, his mental pictures of physical facts that he knows only as sets of equations on page so and so are often hazy at best and sometimes are not entirely correct. The natural result is papers and textbooks that give excellent examples of English and mathematical decoration but are marred by misconceptions or outright mistakes in physical fact.

Holslag's letter, it seems to me, is somewhat overdrawn, even if we omit the wide field of mathematical physics. Yet it does not go to the root of the trouble, if my experience and observation may be trusted. The primary fault is not exhibition mathematics in published papers and texts but rather is the method of instruction now current in some prominent universities. Some authors of unnecessary mathematics are merely following training and example.

Nevertheless, in a certain university a researcher did not search the pertinent *mathematical* literature, apparently never had heard of statistical results and the probability curve, and published findings that were wholly wrong because he averaged readings for factors that were unrelated! Even simple arithmetic tells us to break down products into prime factors, a step that this researcher omitted.

These opposing incidents show that both sides of a narrow road permit a driver to get off it, especially when the road is not well defined.

Very truly yours,

HENRY HENDRICKS KETCHAM (A'13, M'23)

(8 West Church Street, Bethlehem, Pa.)

To the Editor:

The letter "Preparation of Manuscripts" published in the May 1938 issue is pertinent to discussions of socialization of engineering education. It presents the human, the commonsense view which must hold in such matters.

Lately it has become fashionable to accept two statements: (1) Science (and thus engineering) is a major cause of present socio-economic distress. (2) An increased application of scientific method to the interests of men must perfect a scheme to bring humanity back from the abyss toward which unthinking devotion to the machine has lead the way.

Unfortunately, as working hypotheses for improving the state of society, neither of these statements can serve. Reliance on the mystical benignities of old-fashioned business and the higher salesmanship is what has got us to where we are. As to whether the "methods" of science will be permitted gratuitously to drag society from its self-made chaos, Mr. Holslag's letter gives more than a gentle hint.

I sincerely trust further comments will be received.

Very truly yours,

J. ANDREW DOUGLAS (A'18, M'29)

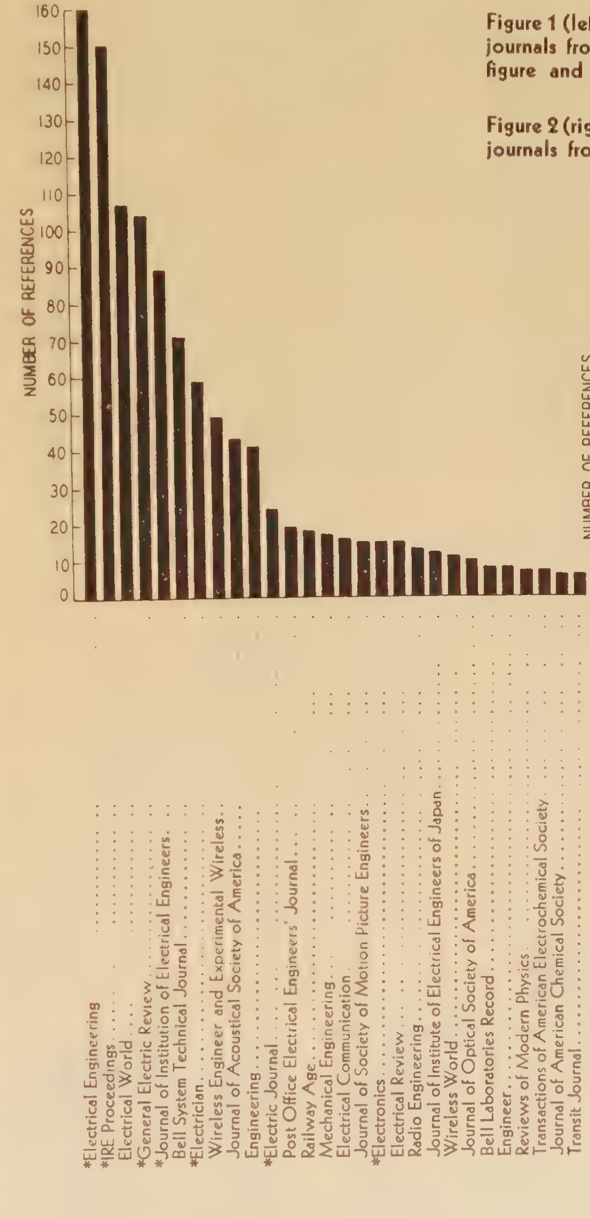
(Physics and General Science Teacher, Murphy High School, Mobile, Ala.)

Journals for Electrical Engineers

To the Editor:

The article in the March 1938 issue of ELECTRICAL ENGINEERING by Charles F. Dalziel concerning "Journals for Electrical Engineers" indicates that the task of keeping fully abreast of the advances which are reported in the literature of electrical engineering is a large one. It has occurred to me that Mr. Dalziel's article could serve as a starting point for some simplification of the task.

Of the total number of 20 basic journals from which Mr. Dalziel's reference counts were made there were eight which are journals of physics rather than engineering. It seemed to me that references taken from these journals would not be to engineering work, nor to physics which is a direct foundation of engineering. Consequently, I made new totals, omitting the references from the following journals: *Proceedings of the Physical Society*, *Philosophical Magazine*, *Journal of the Franklin Institute*, *Physical Review*, *Comptes Rendus*, *Physikalische Zeitschrift*, *Zeitschrift für Physik*. These totals I have arranged in graphical form, grouping English language journals together in one graph, and foreign language journals together in another graph as did Mr. Dalziel. However, I have not included in my lists any journals, the contents of which are listed by the American Institute of Physics in the "Current Literature of Physics" section of its journals. These were omitted because it is my suggestion that ELECTRICAL ENGINEERING undertake the publication in a similar manner of the titles of current articles that appear in a selected group of engineering journals. Such a listing would enable one to review contemporary engineering literature very quickly. It would not replace the abstract journals, but would provide a prompt and easily available source of reference.



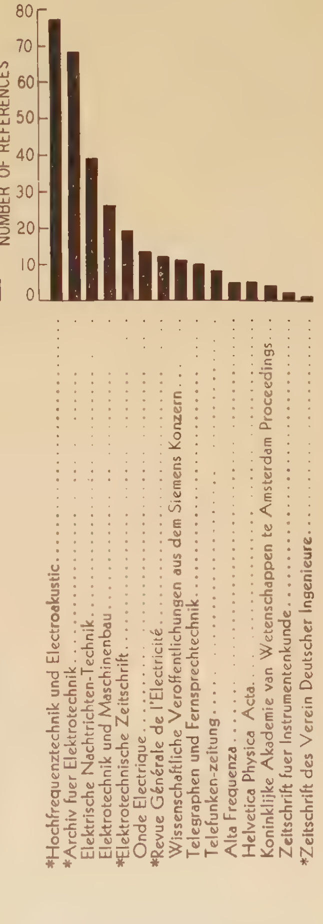


Figure 1 (left). References to English-language journals from journals marked * on both this figure and figure 2, omitting self-references

Figure 2 (right). References to foreign-language journals from journals marked * on figure 1, omitting self-references

The selection of journals to be listed would naturally be governed to a great extent by the wishes of the readers of ELEC-

TRICAL ENGINEERING, but perhaps my graphs could give a preliminary selection. I have indicated a selection of 18 English and ten foreign-language journals, which seem to me to cover the ground fairly well, but which is, of course, an arbitrary one and is given primarily to serve as a basis for discussion.

Very truly yours,

GEORGE B. HOADLEY (A'35)

(Instructor in Electrical Engineering, Massachusetts Institute of Technology, Cambridge)

What Is Tensor Analysis?

To the Editor:

I have read with much interest and pleasure "What Is Tensor Analysis?" by Doctor Banesh Hoffmann and his article is the best elementary analysis of the subject which I have seen.

His development of the Pythagarean interval $ds^2 = dx^2 + dy^2$ into a geodesic by testing it by translation, rotation, their combination, stretching, and changing the angles between the co-ordinate axis is unique and brilliant.

He employs the interval ds^2 as a function of the basic vector $(dx)^i$ identified with a geometrical displacement in space, which is the fundamental measure number of tensor calculus, which in turn is generally called the absolute differential calculus, because $(dx)^i$ was considered from 1905 to 1928 as being the absolute measure number, and for beginners Doctor Hoffmann's application is perfect.

If this system of space were linear and non-Euclidian in one direction only we would write the interval ds^2 as

$$ds^2 = g_{11}dx_1^2 \tag{1}$$

If space were considered to be of 2 dimensions, equation 1 becomes

$$ds^2 = g_{11}dx_1^2 + g_{22}dx_2^2 + 2g_{12}dx_1dx_2 \tag{2}$$

In three-dimensional space we would write:

$$ds^2 = g_{11}dx_1^2 + g_{22}dx^2 + g_{33}dx^2 + 2g_{12}dx_1dx_4 + 2g_{13}dx_1dx_3 + 2g_{23}dx_2dx_3 \tag{3}$$

And in 3 + 1-dimensional space (Einsteinian) equation 1 becomes

$$ds^2 = g_{11}dx_1^2 + g_{22}dx_2^2 + g_{33}dx_3^2 + g_{44}dx_4^2 + 2g_{12}dx_1dx_2 + 2g_{13}dx_1dx_3 + 2g_{14}dx_1dx_4 + 2g_{23}dx_2dx_3 + 2g_{24}dx_2dx_4 + 2g_{34}dx_3dx_4 \tag{4}$$

Therefore we may define space of n dimensions in this system as:

$$ds^2 = \sum_1^m \sum_1^n \Big[g_{mn}dx_n^2, (m = n = 1, 2, 3 \ldots) + 2g_{mn}dx_mdx_n \times (m \neq n \text{ and } m < n;\ m, n, = 1, 2, 3, \ldots) \Big]$$

In all of these symmetrical equations the g's are functions of the co-ordinates x_1, x_2, x_3, x_4. . . .

The common conception of space is an empty geometrical space. This is wholly untrue, because space in fact is the domain of the probability distribution of a particle. In other words we have learned that it is an essential characteristic of space that it is either occupied, or at least that it, at the present, has a finite probability of being occupied.

The form of the right-hand side of the above equations corresponds to the reality of observation, but our left hand measure number, ds^2 is in fact merely a convention. The above equations report ds^2 to be some quadratic function of the differences of the chosen co-ordinates.

Just ten years ago an additional and different measure number to ds^2 was presented by P. A. M. Dirac when he introduced his four-valued wave tensor ψ in his unsymmetrical equation which also is invariant to translation, rotation, and to the Lorentz transformation.

Further study of ψ has now shown that our previously considered "absolute" measure number ds^2 is merely a special case of the latter, even as Euclidean space is a special case of Einstein's 3 + 1 space. Neither ds^2 nor Dirac's four-valued wave tensor ψ can be accepted in the present state of our knowledge as our ultimate measure number in the absolute sense.

Very truly yours,

CLARENCE E. ROSE (M'34)

(Senior Engineer Examiner, United States Public Works Administration, Washington, D. C.)

Electronic Switching Circuits

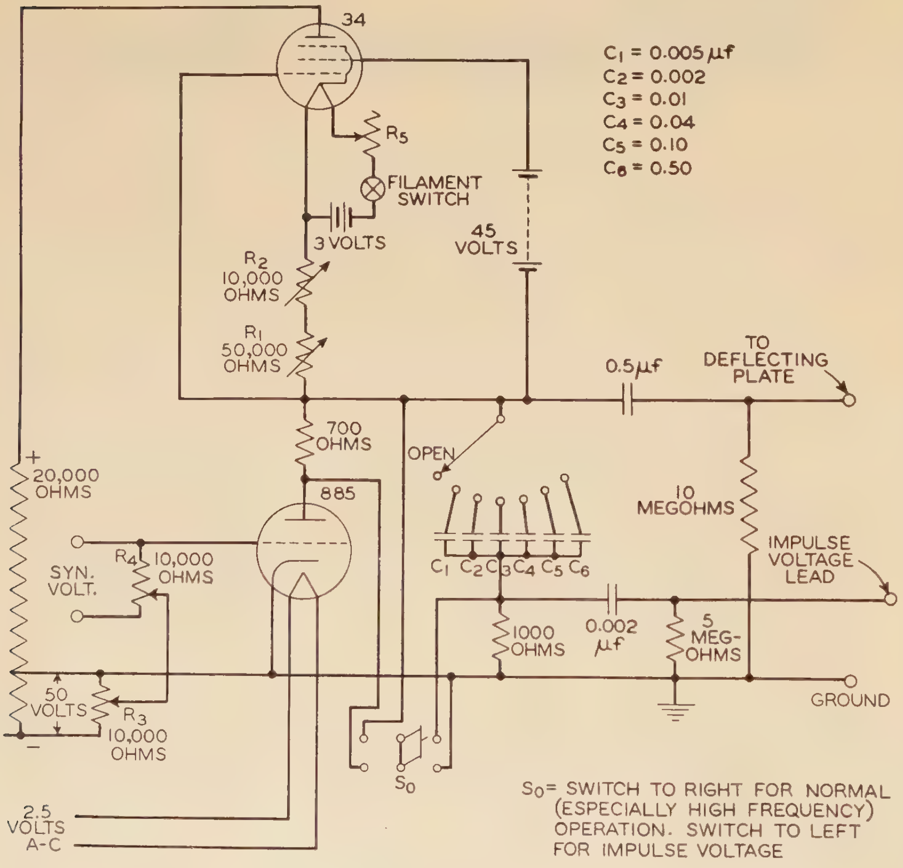
To the Editor:

We read with much interest the article in the May 1938 issue of ELECTRICAL ENGINEERING entitled "Some Electronic Switching Circuits," by C. C. Shumard. We should like very much to discuss one feature of this paper. We developed an impulse-voltage generator somewhat similar in principle to that described in figure 6 of Mr. Shumard's article. We arranged the circuit as indicated in figure 1 of this letter. By supporting the type-34 linearity tube on porcelain insulators, together with its filament and screen-biasing batteries, we were able to reduce the capacitance until we could get a voltage impulse lasting one microsecond. We were not able to reduce the time of the impulse below this minimum figure. Mr. Shumard states that with the assumed values of resistance and capacitance the minimum impulse interval should be 1/4 microsecond. We attempted to use a circuit like that described in figure 6a of his article, but found that the capacitance between ground and the anode side of the type-885 tube was too great to obtain the impulse duration mentioned. We should like very much to know if Mr. Shumard was successful in obtaining an impulse of 1/4 microfarad duration. If he obtained this low time interval, we should like to know what special provisions, if any, he made in the design of the sweep circuit.

Very truly yours,

H. A. BROWN (A'16, M'26)
P. W. RYBURN

(Department of Electrical Engineering, University of Illinois, Urbana)



So= SWITCH TO RIGHT FOR NORMAL (ESPECIALLY HIGH FREQUENCY) OPERATION. SWITCH TO LEFT FOR IMPULSE VOLTAGE

Figure 1

Personal Items

F. E. Johnson (A'13, F'31) has been appointed dean of the college of engineering of the University of Wisconsin, Madison. Since 1935 dean of the college of engineering of the University of Missouri, Dean Johnson was born May 27, 1885, at LeRoy, Mich., and received the degrees of bachelor of arts (1906) and electrical engineer (1909) at the University of Wisconsin. Following a period of employment in substation construction work in the western part of the United States and Canada, he was appointed instructor in electrical engineering at The Rice Institute, Houston, Texas, in 1912. Dean Johnson was appointed instructor in electrical engineering at the University of Kansas in 1915, and became successively assistant professor, associate professor, and professor of electrical engineering. In 1928 he was appointed head of the department of electrical engineering; however, he resigned in the same year to become head of the department of electrical engineering at Iowa State College, Ames. A director of the Institute, Dean Johnson has served during the year just ending as a member of the Institute's committee on education, electrical machinery, and membership; and as chairman of the committee on student branches. He is Institute representative on the Engineers' Council for Professional Development.

J. W. Dawson (M'35) has received the AIEE national prize award for best paper in engineering practice for his paper "New Developments in Ignitron Welding Control." Mr. Dawson was born at Sumner, Iowa, in 1901, and was graduated from Iowa State College in 1926 with the degree of bachelor of science in electrical engineering; in 1938 he received the degree of master of science from the University of Pittsburgh. In 1926 he became affiliated with the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., as student engineer, and from 1927 until 1937 he was employed continuously in the engineering department of that company. Early in 1938 he left the employ of the Westinghouse company to become research and development engineer for the Raytheon Production Corporation, Newton, Mass. During the year just ending Mr. Dawson has been a member of the Institute's committee on electric welding and the joint subcommittee on electronics.

R. W. Warner (M'28) has become professor and head of the department of electrical engineering at the University of Texas, Austin. Professor Warner is a native (1889) of Freeport, Ill. He was graduated from Washburn College with the degree of bachelor of arts, later attending the University of Kansas and receiving there the degrees of bachelor of science in electrical engineering (1918) and electrical engineer (1928). After holding various positions Professor Warner became assistant to the chief engineer of the Topeka Edison Company, Topeka, Kans., in 1920, but in the following year was appointed instructor in electrical engineering at the University of Kansas. In 1922 he became instructor in electrical engineering at the University of Wisconsin, but remained only one year before becoming affiliated with the General Electric Company, Schenectady, N. Y. Professor Warner became an engineer for the Kansas City (Mo.) Power and Light Company in 1924 and held that position until he returned to the University of Kansas as assistant professor of electrical engineering in 1928. In the following year he was promoted to associate professor, and in 1929 he received his professorship. Since 1936 he has been head of the department of electrical engineering. During 1935–36 he served as an exchange professor of electrical engineering at Massachusetts Institute of Technology.

Reuben Reiter (A'36) has been awarded the AIEE national prize award for best paper in theory and research with C. L. Dawes (A'12, F'35), co-author of the paper "Electrical Characteristics of Suspension-Insulator Units." A native of London, England, Doctor Reiter attended Harvard University and received the degrees of bachelor of science in electrical engineering and business administration and doctor of science, the last degree in 1935. From 1931 until 1935 he was research assistant and part-time instructor at Harvard. Doctor Reiter at present is engaged in consulting work for several small sound and music companies, and is technical director of research at the New York Institute for the Education of the Blind, New York, N. Y.

E. O. Shreve (A'06) recently became the first recipient of the Marston medal, an award initiated in 1938 by Iowa State College to honor outstanding achievement in engineering by its alumni. Mr. Shreve was graduated from Iowa State College in 1904 with the degree of bachelor of science in electrical engineering, following which he became associated with the General Electric company as a student engineer. In 1906 Mr. Shreve was sent to San Francisco, Calif. as a supply salesman, and in the following year was assigned to the company's Nevada territory. In 1909 he was recalled to San Francisco as turbine specialist and two years later was made apparatus salesman in charge of sales to the Pacific Gas and Electric Company, successively becoming manager of apparatus sales, assistant manager of the San Francisco office, and manager of that office. Later Mr. Shreve was sent to Schenectady, N. Y., as manager of the industrial department of the General Electric Company and shortly thereafter was elected an assistant vice-president. In 1934 he was elected vice-president in charge of sales, the position he now holds.

Sterling Beckwith (A'34) has received honorable mention in the AIEE national prize awards for best paper in engineering practice for his paper "Approximating Potier Reactance." A native (1906) of Carthage, Mo., Mr. Beckwith was graduated from Stanford University in 1927 with the degree of bachelor of science in electrical engineering. In the same year he entered the student training course of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., later attending the design school of that company for six months and then joining the power engineering department. In 1929 he received the degree of master of science from the University of Pittsburgh in pursuing the co-operative course of study with the Westinghouse company. In 1931 he was awarded a teaching assistantship in the electrical engineering department of California Institute of Technology. He received the degree of doctor of philosophy at that Institution in 1933, then worked for two years as junior engineer with the Metropolitan Water District of Southern California. In 1935 Mr. Beckwith went to Milwaukee, Wis., to join the electrical department of the Allis-Chalmers Manufacturing Company.

John Murphy (A'00, F'13) recently retired from active service. During the last four years Mr. Murphy has been acting superintendent of the Rideau Canal, and has a record of 32 years of service with the Department of Transport and Board of Railway Commissioners, Ottawa, Ont., Canada. Born in Ottawa in 1868, Mr. Murphy was graduated from the University of Ottawa in 1884. Three years later, when the Chaudiere Electric Light and Power Company was established, he was placed in charge

J. W. DAWSON

REUBEN REITER

F. E. JOHNSON

of the company. In 1891 the Ottawa Electric Railway Company was formed and Mr. Murphy was placed in charge of the power plant of both the new company and of the Chaudiere company. He was associated with those companies for 20 years and concurrently conducted his own consulting engineering practice. Mr. Murphy was president of the Canadian National Committee of the International Electrotechnical Commission from 1927 until 1937, and was official delegate to the World Power Conferences in 1924 and 1930.

E. W. Schilling (A'29, M'33) recently became head of the department of electrical engineering at Montana State College, Bozeman. A native (1897) of What Cheer, Iowa, Doctor Schilling attended the University of South Dakota and the University of Illinois, receiving the degree of bachelor of science in electrical engineering at the latter school in 1919. From Iowa State College he received the degrees of master of science in electrical engineering (1930), doctor of philosophy (1933), and electrical engineer (1936). After holding various industrial positions Doctor Schilling became instructor in electrical engineering at Iowa State College in 1920. Three years later he established the consulting engineering firm of E. W. Schilling and Company, Brandon, S. D., but in 1928 returned to his previous position on the faculty of Iowa State College. In 1931 he was appointed assistant professor of electrical engineering at Michigan College of Mining and Technology, Houghton, being advanced to the position of associate professor in 1934. Doctor Schilling is author or coauthor of several papers presented before the Institute.

W. M. Skiff (A'07, M'33) has retired as manager of the Nela Park engineering department of the General Electric Company, Cleveland, Ohio, a position he has held since 1930. Mr. Skiff was born in 1883 at Jamestown, N. Y., and was graduated from the Case School of Applied Science with the degrees of bachelor of science (1906) and electrical engineer (1930). Following his graduation in 1906 he became affiliated with the engineering department of the National Electric Lamp Association and in the following year was appointed office manager of the Association. In 1912, when that organization became a part of the General Electric Company, he was appointed manager of the engineering department of the National Lamp Works. In 1930 the engineering department of the National Lamp Works and the Edison Lamp Works were combined with the Nela Park engineering department of the General Electric Company, and Mr. Skiff was appointed manager of the consolidated departments.

H. H. Skilling (A'28, M'34) has received the AIEE Pacific District prize for best paper with P. deK. Dykes, co-author of the paper "Distortion of Traveling Waves by Corona." Doctor Skilling is assistant professor of electrical engineering at Stanford University, Calif., from which he received the degrees of bachelor of arts (1926), engineer in electrical engineering (1927), and doctor of philosophy (1931). In 1930 he was awarded the master of science degree by Massachusetts Institute of Technology. From 1927 until 1929 Doctor Skilling was employed in the construction department of the Southern California Edison Company. Since 1929, except for the period of graduate study at MIT, he has been a member of the electrical engineering faculty of Stanford University. He has presented several papers on power transmission before the Institute.

Shiv Narayan (A'10, M'13) has been appointed principal of the college of engineering, Poona, India. Professor Narayan was born at Delhi, India, in 1883, and received the degrees of bachelor of science and master of arts at Forman Christian College (Lahore, India) and Government College, respectively. Later he came to the United States and received the degree of bachelor of engineering in electrical engineering at Union College in 1909. Following his graduation from Union College he returned to India and for three years held various positions with electric power companies. In 1913 he was appointed assistant professor of electrical engineering in the Poona College of Engineering, eventually becoming professor of electrical engineering and physics. Professor Narayan has written several books on hydroelectric power plants in India and on electrical machinery.

E. O. Lunn (A'32) has received the AIEE Canada District prize for best paper and prize for initial paper for his paper "Induction Motors Under Unbalanced Conditions." Mr. Lunn is engineer for the Peterson and Cowan Elevator Company, Ltd., Vancouver, B. C., Canada. A native (1909) of Albert, N. B., Canada, he was graduated from the University of British Columbia in 1930 with the degree of bachelor of applied science in electrical engineering. Following his graduation he entered the student training course of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., but shortly thereafter became electrical engineer for the Turnbull Elevator Company, Toronto, Ont., Canada, where he remained for almost five years. He has been associated with the Peterson and Cowan Elevator Company during the last three years.

W. T. Thomson (A'37) has received the AIEE Pacific District prize for initial paper for his paper "Resonant Nonlinear Control Circuits." Mr. Thomson was born in Kyoto, Japan, in 1909, and received the degrees of bachelor of science in electrical engineering (1933) and master of science in electrical engineering (1934) at the University of California. During 1935–36 he was a teaching assistant in physics and mathematics at the University of California agricultural college at Davis, and in the same year was assigned to a research project on solar radiation at that institution. During 1936–37 he was a university fellow in electrical engineering at the Berkeley branch of the University of California. He now is instructor of applied mechanics at the Kansas State College of Agriculture and Applied Mechanics, Manhattan.

C. F. Hirshfeld (A'05, F'36) has been granted the honorary degree of doctor of engineering by the University of Detroit. According to the citation, Doctor Hirshfeld "has led a movement to liberalize and humanize the engineering profession by advocating in it not only the highest technical knowledge and skill, but also a broad general culture and a sense of social and civic responsibility . . . . to permit those worthy purposes, has been the first chairman and constant guide and leader of the Engineers' Council for Professional Development, an organization which has already in six brief years greatly enhanced the dignity of the engineering profession and more particularly, the academic value of engineering education." Doctor Hirshfeld is chief of research of the Detroit Edison Company and past chairman of ECPD.

A. L. Samuel (M'34) recently received the prize of the Institute of Radio Engineers for the best paper published in the IRE *Proceedings* during 1937. Mr. Samuel was born in 1901 at Emporia, Kans., and was graduated from the College of Emporia with the degree of bachelor of arts in 1923. He then enrolled in Massachusetts Institute of Technology and received there the degrees of bachelor of science in electrical engineering (1925) and master of science in electrical engineering (1926). During the time he attended Massachusetts Institute of Technology he was employed in various positions by the General Electric Company. Following his graduation in 1926 he served for two years as instructor in electrical engineering at MIT, and since 1928 has been a member of the technical staff of the Bell Telephone Laboratories, New York, N. Y.

C. F. Dalziel (A'33) has been promoted to assistant professor of electrical engineering at the University of California, Berkeley. Professor Dalziel is a native (1904) of San Francisco, Calif., and received the degrees of bachelor of science (1927), master of science (1934), and electrical engineer (1935) at the University of California. He was employed by the General Electric Company and the San Diego Consolidated Gas and Electric Company prior to joining the faculty of the University in 1932. He is the author of a paper "Static Power Limits of Synchronous Machines," scheduled to be presented at the AIEE pacific coast convention, Portland, Ore., August 9, 1938.

J. L. C. Löf (Enrolled Student) has received the AIEE North Central District prize for Branch paper for his paper "The Efficiency of Small Electric Motors." Mr. Löf is a native of Denver, Colo., and was graduated from the University of Denver with the degree of bachelor of science in electrical engineering in June 1938.

M. B. Wyman (A'30, M'35) has been transferred to East Pittsburgh, Pa., as manager of the district engineering department of the Westinghouse Electric and Manufacturing Company. Mr. Wyman formerly was engineering manager of the southwestern district of the Westinghouse company, with offices at St. Louis, Mo.

H. C. Sutton (A'10, M'17) has been elected president of the Association of American Engineers in Cuba. Mr. Sutton is a native of Philadelphia, Pa., and a graduate of Cornell University in mechanical and electrical engineering. For several years he was associated with the United Gas Improvement Company of Philadelphia, of which organization he was chief engineer from 1927 until 1930. Since 1930 he has been chief engineer of the Cuban Electric Company, a subsidiary of the American and Foreign Power Company, with headquarters in Havana.

F. I. Morgan (A'31) has received the AIEE Middle Eastern District prize for initial paper for his paper "An Electrical Governor." Mr. Morgan was born in 1889 at Linwood, N. Y. In 1909 Mr. Morgan became affiliated with the Genesee Light and Power Company, Batavia, N. Y., remaining there until 1914, when he joined the Schenectady Power Company. Since 1915 Mr. Morgan has been employed by the Pennsylvania Water and Power Company, for several years at Holtwood, Pa., and more recently as maintenance engineer at Baltimore, Md.

M. G. Lloyd (A'08, F'12) recently was elected president of the Washington (D. C.) Safety Society. Doctor Lloyd is chief of the section of safety codes, National Bureau of Standards, Washington, D. C., and is representative of the Department of Commerce upon the Federal Interdepartmental Safety Council. During the year just ending he has been a member of the Institute's committee on safety; he is also past chairman of the AIEE Washington Section.

W. L. Enfield (A'10, F'32) recently received the degree of doctor of engineering from Kansas State College of Agriculture and Applied Science. The degree was granted to Mr. Enfield "in recognition of the outstanding service he has rendered in the advancement of lighting progress." Since 1914 Mr. Enfield has been manager of the lamp development laboratory in the incandescent lamp department of the General Electric Company, Cleveland, Ohio.

J. F. Porter (A'87, F'33) recently received the Chicago alumni merit award given by the Chicago Alumni Association of Iowa State College. The award was granted "in recognition of outstanding service and contributions to humanity." Mr. Porter, who is chairman of the board of directors of the Kansas City (Mo.) Power and Light Company, was graduated from Iowa State in 1884.

B. R. Prentice (A'35) has received the AIEE North Eastern District prize for initial paper for his paper "Fundamental Concepts of Synchronous Machine Reactances." Mr. Prentice received honorable mention in the 1937 AIEE national prize awards for the same paper, as announced on page 324 of the July 1938 issue of Electrical Engineering.

Dean Harvey (A'04, M'13) has been elected a member of the executive committee of the American Society for Testing Materials for the two year term 1938–40. Since 1911 Mr. Harvey has been materials engineer in the central material and process engineering department of the Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa., and has been active in committee work of ASTM.

C. J. Wells (M'37) has become Western regional electrical engineer for the United States National Park Service (erroneously reported in the May 1938 issue as United States Irrigation Service), with headquarters at Santa Fe, N. M. Mr. Wells formerly was electrical engineer for the United States Irrigation Service at Coolidge, Ariz.

Alex Dow (A'93, F'13, HM'37) recently received the honorary degree of doctor of arts in business administration from Wayne University. AIEE Edison medalist in 1936, Doctor Dow has received several other honorary engineering degrees. He is president of the Detroit (Mich.) Edison Company.

F. H. Travers (A'26, M'32) has been appointed electrical engineer in the State Department of Public Works, Hartford, Conn. Mr. Travers formerly was employed in the wiring device engineering department of the General Electric Company, Bridgeport, Conn.

M. G. Lewis (A'36) has become junior electrical engineer for the Golden Gate International Exposition, San Francisco, Calif. Mr. Lewis formerly was electrical engineer for the University Electric Company, Santa Clara, Calif.

A. LeG. Ritter (A'33) has been appointed an inspector for the Federal Communications Commission, San Pedro, Calif. Formerly Mr. Ritter was a radio engineer for station KHJ, Don Lee Broadcasting Company, Los Angeles, Calif.

A. W. Robertson (A'27) has been elected to the board of directors of the National Association of Manufacturers. Mr. Robertson is chairman of the board of the Westinghouse Electric and Manufacturing Company, Pittsburgh, Pa.

J. C. Stevens (A'20, M'30) recently received the honorary degree of bachelor of engineering from Oregon State College. Doctor Stevens is a consulting engineer in the firm of Stevens and Koon, Portland.

L. M. Smith (A'35) recently became an engineer for The Lane-Wells Company, Vernon, Calif. Mr. Smith has been an engineer for the General Electric Company, Ontario, Calif.

G. J. Amorosi (A'34) has become a draftsman for the Cole Electric Products Company, Inc., Long Island City, N. Y.

Obituary

Samuel Insull (A'86, M'12, F'12) retired chairman of the board of the Commonwealth Edison Company, Chicago, Ill., died July 15, 1938. Doctor Insull was born November 11, 1859, in London, England, and was educated in private schools in London and later at Reading and Oxford. He received the degree of doctor of science from Union College in 1917 and the degree of doctor of laws from Northwestern University (1926), Notre Dame University (1926), and Queen's University (Canada, 1930). In 1881 he came to the United States, becoming private secretary to Thomas A. Edison, of whose business affairs he had charge for many years. Doctor Insull represented the Edison interests in the organization and management of The Electric Tube Company, Edison Machine Works, and Edison Lamp Company. He was the first general manager of the Edison Machine Works, and in 1889, when the various Edison manufacturing organizations were consolidated into the Edison General Electric Company, he was appointed second vice-president in charge of manufacturing and sales. When the Edison General Electric Company was merged with the Thomson-Houston Company to form the General Electric Company in 1892, Doctor Insull became second vice-president of the new company. He resigned in the same year, however, to become president of the Chicago Edison Company and the Consolidated Electric Company. In 1907 the two companies were merged to form the Consolidated Edison Company, with Doctor Insull as president. He became chairman of the board in 1930, and was an officer or director of many other public utility companies until his retirement in 1932.

Sir John Francis Cleverton Snell (A'06, M'06, F'12) former chairman of His Majesty's Electricity Commissioners, London, England, died July 6, 1938. Sir John was born December 15, 1869, at Saltash, Cornwall, and was educated at King's College in London. For three years he was assistant engineer for Crompton and Company, in which position he became engaged in central-station work in both England and Sweden. He then became chief assistant to a consulting engineer for three years before being appointed resident engineer for the Borough Council in London. Sir John was Borough Electrical and Tramways Engineer to the Sunderland Corporation for $9^{1}/_{2}$ years before becoming a partner in the firm of Preece, Cardew, and Snell in 1906. He continued in private consulting work until 1918. He was knighted in 1914, and during 1914–15 was president of the Institution of Electrical Engineers. From 1926 until 1931 he was a vice-president of the Institution of Civil Engineers. At various times Sir John was a member of the British Advisory Council for Scientific and Industrial Research, chairman of the Water Power Resources Committee, and chairman of the Committee on Electroculture of the Ministry of Agriculture. He retired as chairman of the Electricity Commission at the end of 1937. Sir John was the Faraday Medalist of the Institution of Electrical Engineers in 1938.

Thomas Ahearn (A'87, M'87) president of the Ottawa Electric Company, Ottawa Electric Railway Company, Ottawa Car Manufacturing Company, and Ahearn and Soper, Ltd., Ottawa, Ont., Canada died June 28, 1938. Mr. Ahearn was born in Ottawa, June 24, 1855, and began his career as a telegraph operator in 1870. Later he pioneered in the telephone field in Ottawa, taking charge of the telephone branch of the Montreal Telegraph Company in 1878. In 1883 Mr. Ahearn became a partner in the firm of Ahearn and Soper, an electrical contracting organization which later planned and founded many electrical companies. He was a founder in 1887 of the Chaudiere Electric Light and Power Company, merged in the Ottawa Electric Company in 1893, and, with the Ottawa Gas Company, absorbed by the Ottawa Light, Heat, and Power Company. He was also a founder of the Ottawa Electric Railway Company. In 1928 he was rewarded for his enterprise in business and industry by appointment to the Privy Council. Mr. Ahearn served as a director of the Bell Telephone Company of Canada, the Canadian Westinghonse Company, Ltd., the Northern Electric Company, and various other organizations.

Andrew James Cunningham (A'35, M'36) electrical traction engineer for the Metropolitan-Vickers Electrical Company, Ltd., Manchester, England, died in December 1937, according to word just received at Institute headquarters. Mr. Cunningham was born November 19, 1892, at Edinburgh, Scotland, attended Emmanuel College and Battersea Polytechnic, and was graduated in electrical engineering from the City and Guilds Institute of London, in 1916. From 1915 until 1918 he was associated with Buller, Ltd., London, and from 1918 until 1922 was electrical and civil engineer for the Twiss Electric Transmission Company, London. He held a similar position with Merz and McLellan, London, from 1922 until 1933. He became affiliated with the Metropolitan-Vickers Company in 1933, and represented that company in the design and construction of electrified railway systems on five continents.

Charles Norman Brubaker (A'19, M'29) manufacturing engineer of the power transformer department, General Electric Company, Pittsfield, Mass., died May 3, 1938. Mr. Brubaker was born at Liverpool, Pa., February 2, 1886, and was graduated from Bucknell University in 1911. Following his graduation he entered the General Electric Company's test course at Schenectady, N. Y. Upon completion of his duties in the test course, Mr. Brubaker served as a designing engineer before being transferred to Fort Wayne, Ind., in 1920. Six years later he moved to the Erie (Pa.) works of the General Electric Company, where he was appointed managing engineer of the transformer section. He became manufacturing engineer in the power transformer department at Pittsfield in 1932.

Burt J. Denman (A'11) vice-president and general manager of the United Light and Power Company, Chicago, Ill., died June 25, 1938. Mr. Denman was born April 30, 1876, at Toledo, Ohio, and was graduated from the University of Michigan in 1899 with the degree of bachelor of science in electrical engineering. Following his graduation he served for two years as instructor at Toledo University, following which he became electrical engineer for the Toledo, Bowling Green, and Southern Traction Company, remaining with that company until 1904, when he became an engineer for The Detroit Edison Company. He became vice-president and general manager of the United Light and Power Company and the United Light and Railway Company in 1913.

Richard J. Knaur (A'22) died April 26, 1938. Mr. Knaur was born January 17, 1870, at Maehrisch Ostrau, Austria, and attended the Technical University of Vienna. Early in his career Mr. Knaur took the student test course of the General Electric Company, Schenectady, N. Y., then went to Vienna to work for Siemens and Halske. In 1904 he became technical manager of Felten and Guilleaume, Vienna. He kept that position until 1922, when he was appointed general manager. In 1936, after 31 years of active service with Felten and Guilleaume, he resigned his position as general manager and was elected member and chairman of the board.

Dinshaw Pestonji Munshi (A'32), chief mechanical and electrical engineer for the Burhanpur Taft Mills, Ltd., Burhanpur, India, died December 16, 1937, according to word just received at Institute headquarters. Mr. Munshi was born June 6, 1882, at Naresari, India and was graduated from the Technological Institute of Great Britain in 1929. In 1900 he was employed by the New Great Eastern Spinning and Weaving Mills, Ltd., remaining there for seven years before becoming associated with the Lakhshmi Cotton Mills, Ltd., Sholapur, India. He entered the employ of the Burhanpur Taft Mills, Ltd., in 1920.

Algy Ross Battern (A'20) assistant general manager of the Iowa Public Service Company, Sioux City, died recently. Mr. Battern was born November 13, 1890, at Storm Lake, Iowa, and attended Highland Park College (Des Moines, Iowa). From 1910 until 1915 he was employed by the Storm Lake Electric Light and Power Company, Storm Lake, Iowa, in the latter year becoming a meterman for the Iowa Light, Heat, and Power Company at Storm Lake. Eventually he became engineer, and remained with that company until 1928, when he became affiliated with the Iowa Public Service Company.

Edson F. Packer, Jr. (A'36) draftsman for the Electric Service Supplies Company, Philadelphia, Pa., died June 13, 1938. Mr. Packer was born February 18, 1913, at Philadelphia, and was graduated from Drexel Institute with the degree of bachelor of science in electrical engineering in 1935. Following his graduation he entered the employ of the Electric Service Supplies Company and had served for three years as a draftsman.

Membership

Recommended for Transfer

The board of examiners, at its meeting on July 21, 1938, recommended the following members for transfer to the grade of membership indicated. Any objection to these transfers should be filed at once with the national secretary.

To Grade of Fellow

DuVall, W. C., professor of electrical engineering, University of Colorado, Boulder.
Stanbury, Carroll, development engineer, Cutler-Hammer, Inc., Milwaukee, Wis.
Stevens, Theodore, consulting engineer, Herne Bay, England.
Scott-Taggart, John, consulting engineer, Harlow Laboratories, Frinton-on-Sea, England.

4 to Grade of Fellow

To Grade of Member

Battey, P. L., senior partner, Battey and Childs, Chicago, Ill.
Book, C. F., meter engineer, Hydroelectric Power Commission of Ontario, Niagara Falls, Ont., Canada.
Bower, M. M., transmission engineer, Bell Telephone Laboratories, Inc., New York, N. Y.
Breon, K. H., power engineer, Pennsylvania Power and Light Company, Williamsport, Pa.
Burlingame, R. E., electrical and radio engineer and patent attorney, Williamson and Williamson, Minneapolis, Minn.
Comstock, C. W., consulting engineer, Jackson Heights, N. Y.
Helwig, W. O., secretary, Helwig Company, Milwaukee, Wis.
Kingdon, H. F., works manager, Commonwealth Electric Corporation, Ltd., Welland, Ont., Canada.
Knaus, Fred, senior contract agent, lighting department, city of Seattle, Wash.
Lawrence, W. T., eastern district engineer, Automatic Electric Company, New York, N. Y.
Lehman, C. D., engineer, The National Board of Fire Underwriters, Chicago, Ill.
Miller, J. F., assistant superintendent, Louisville Gas and Electric Company, Louisville, Ky.
Moench, H. A., assistant professor of electrical engineering, Rose Polytechnic Institute, Terre Haute, Ind.
Osborne, I. H., electrical engineering, Federal Shipbuilding and Dry Dock Company, East Orange, N. J.
Roberts, L. C., engineer, Bell Telephone Laboratories, Inc., New York, N. Y.
Smith, C. E., assistant chief engineer, Radio Stations WHK-WCLE, Cleveland, Ohio.
Smith, M. T., engineer, General Radio Company, Hollywood, Calif.
Sutton, L. V., president, general manager, and director, Carolina Power and Light Company, Raleigh, N. C.

18 to Grade of Member

Applications for Election

Applications have been received at headquarters from the following candidates for election to membership in the Institute. If the applicant has applied for direct admission to a grade higher than Associate, the grade follows immediately after the name. Any member objecting to the election of any of these candidates should so inform the national secretary before August 31, 1938, or October 31, 1938, if the applicant resides outside of the United States or Canada.

United States and Canada

Almond, E. P. (Member), Tennessee Valley Authority, Knoxville, Tenn.
Biggs, R. N., City Hall, Petersburg, Va.
Blum, L. M., 1844 Clay Avenue, Bronx, New York, N. Y.
Chadwick, W. L. (Member), Southern California Edison Company, Los Angeles, Calif.
Chaney, J. G., Texas Agricultural and Mechanical College, College Station.
Doll, E. B., University of Kentucky, Lexington.
Edie, L. C., Western Union Telegraph Company, Dallas, Texas.

Ellsworth, B. E. S., Iowa-Nebraska Light and Power Company, Lincoln, Nebr.
Hawksley, R. W., Columbia Steel Company, San Francisco, Calif.
Hoff, O. C., The Pacific Telephone and Telegraph Company, Portland, Ore.
Howe, E. E., Potomac Electric Power Company, Washington, D. C.
Keller, W. J., Sr., 203 Natchez Building, New Orleans, La.
King, D., The Shawinigan Water and Power Company, Montreal, Que., Canada.
Mahler, R. J., Central Hudson Gas and Electric Corporation, Poughkeepsie, N. Y.
Marny, R. G., Hotel New Yorker, New York, N. Y.
Masters, D. B., Commonwealth and Southern Corporation, Jackson, Mich.
Nodder, W. R., Pacific Electric Manufacturing Corporation, San Francisco, Calif.
Redeker, I. M., Stanford University, Stanford University, Calif.
Wallin, M. R. (Member), Union Electric Company of Missouri, St. Louis.
Wallio, M. A., General Electric Company, Pittsfield, Mass.
Williams, J. W. A., International Power and Paper Company, Deer Lake, Newfoundland.

Total, United States and Canada—21

Elsewhere

Beadman, C. B. H. (Member), Callender's Cable and Construction Company, Ltd., Bombay, India.
De Lima, S. J., Power House, Bangalore Cantonment, India.
Doetsch, J. A., Neptun Gold Mining Company, Puerto Cabezas, Nicaragua.

Total, elsewhere—3

Addresses Wanted

A list of members whose mail has been returned by the postal authorities is given below, with the addresses as they now appear on the Institute record. Any member knowing of corrections to these addresses will kindly communicate them at once to the office of the secretary at 33 West 39th St., New York, N. Y.

Ackerson, Cornelius, 2600 West Grand Boulevard, Detroit, Mich.
De Lay, R. E., 77 Prospect Ave., Long Beach, Calif.
Fetter, Charles H., Electrical Research Products, 250 W. 57th St., New York, N. Y.
Kapell, Sidney M., 3043 Emmons Ave., Brooklyn, N. Y.
Lynch, Earl M., 34–40 West Beaver Street, Jacksonville, Fla.
Markham, Thomas C., Jr., 55 Hanson Place, Brooklyn, N. Y.
Neiman, William E., 4060 Elbertson Street, Elmhurst, N. Y.
Nissar, A. R., in care of Thomas Cook and Son, 2 Place de la Madeleine, Paris, France.
Piltch, Abraham, 2224 Eutaw Place, Baltimore, Md.
Platterer, Alvin, 776 N. Cass St., Milwaukee, Wis.
Powers, Walter H., 603 West Washington, Jackson, Mich.
Renking, H. L., 208 N. Broadway, St. Louis, Mo.
Robison, R. L., 941 E. Northlake Ave., Seattle, Wash.
Skina, Fred A., 626 Ash St., Moscow, Idaho.
Whitney, T. G., Electrical Research Products, Inc., 250 W. 57th St., New York, N. Y.
Willick, Francis L., 2397 East Grand Boulevard, Detroit, Mich.

16 Addresses Wanted

Engineering Literature

New Books in the Societies Library

Among the new books received at the Engineering Society Library, New York, recently are the following which have been selected because of their possible interest to the electrical engineer. Unless otherwise specified, books listed have been presented gratis by the publishers. The Institute assumes no responsibility for statements made in the following outlines, information for which is taken from the preface of the book in question.

BOTH SIDES of the MICROPHONE, Training for the Radio. By J. S. Hayes and H. J. Gardner. Philadelphia and New York, J. B. Lippincott Company, 1938. 180 pages, 8 by 5 inches, cloth, $1.25. Discusses the phases of broadcasting which are concerned with programs, sales, publicity, engineering, production, and announcing.

(The) AMERICAN YEAR BOOK, edited by W. M. Schuyler and A. B. Hart. New York, N. Y., Thomas Nelson and Sons, 1938. 993 pages, tables, 8 by 5 inches, cloth, $7.50. A survey of events during the year 1937 in 27 major fields of activity. Economics, business and science are adequately represented, with surveys of the mineral industries, manufactures, transportation, engineering, and construction.

DUODECIMAL ARITHMETIC. By G. S. Terry. New York and Longon, Longmans, Green and Company, 1938. 300 pages, charts, tables, 12 by 10 inches, cloth, $7.50. The number 12 as a base for our number system is strongly advocated in this publication. The author demonstrates the advantages of this system as compared with the base often in various mathematical operations from simple multiplication to the manipulation of the higher mathematical functions.

ELECTRON OPTICS in TELEVISION. By I. G. Maloff and D. W. Epstein. New York and London, McGraw-Hill Book Company, 1938. 299 pages, illustrated, 9 by 6 inches, cloth, $3.50. Develops the theory of electron optics and its most useful application, the television cathode-ray tube. An introduction briefly describes a complete cathode-ray television system and a few applications of electron optics. Following a discussion of electron emission and electron optics, part two discusses the television cathode-ray tube.

ELEKTRISCHE GASENTLADUNGSLAMPEN. By W. Uyterhoeven. Berlin, Julius Springer, 1938. 364 pages, illustrated, 9 by 6 inches, cloth, 36.40 rm.; paper, 34 rm. Theoretical and practical information concerning electric vapor lamps, including electronic and atom theory and the kinetic theory of gases and gaseous discharges. A section on the design of neon, sodium, and low- and high-pressure mercury-vapor lamps is included.

(The) EVOLUTION of PHYSICS. By A. Einstein and L. Infeld. New York, Simon and Schuster, 1938. 319 pages, illustrated, 8 by 6 inches, cloth, $2.50. Intended for the layman without any concrete knowledge of physics and mathematics; is clear and straightforward in style, and authoritative.

MUNICIPAL YEAR BOOK, 1938. Edited by C. E. Ridley and O. F. Nolting. Chicago, International City Managers' Association, 1938. 619 pages, illustrated, 10 by 7 inches, cloth, $5.00. An annual résumé of activities and statistical data of American cities.

PIEZOELEKTRIZITÄT des QUARZES. (Wissenschaftliche Forschungsberichte Naturwissenschaftliche Reihe, Bd. 45.) By A. Scheibe. Dresden and Leipzig, Verlag von Theodor Steinkopff, 1938. 233 pages, illustrated, 9 by 6 inches, paper, 20 rm.; bound, 21 rm. The widely scattered literature on the piezoelectric properties of quartz crystals and their practical applications presented in a review.

REPORTS on PROGRESS in PHYSICS, volume 4, edited by A. Ferguson. Cambridge, England, University Press; London, Physical Society, 1938. 389 pages, illustrated, 10 by 7 inches, leather, $5.00. Issued under the auspices of the Physical Society as an annual survey of advances in physical science. The present volume is as of the end of 1936; includes reviews of the work in heat, spectroscopy, sound, experimental electricity and magnetism, the charge of the electron, atomic physics, and other subjects of interest to electrical engineers.

SEVENTY YEARS of the WORCESTER POLYTECHNIC INSTITUTE. By H. F. Taylor. Worcester, Mass., Worcester Polytechnic Institute, 1937. 415 pages, illustrated, 9 by 6 inches, cloth, $2.00. An account of the founding and development of the Worcester Polytechnic Institute, containing information concerning persons, policies, activities, courses of instruction, and other matters.

TEXT-BOOK of CONVERGENCE. By W. L. Ferrar. Oxford, England, Clarendon Press; New York, Oxford University Press, 1938. 192 pages, diagrams, tables, 9 by 6 inches, cloth, $3.50. A mathematical treatise on convergence, presenting such information necessary for a university course in pure and applied mathematics.

ELEMENTS of THERMODYNAMICS. By E. M. Fernald. Second edition, New York and London, McGraw-Hill Book Company, 1938. 330 pages, diagrams, charts, tables, 9 by 6 inches, cloth, $3.50. A textbook presenting the subject with special reference to its applications in engineering. Includes the customary topics of general phases and states, steam cycles, refrigeration cycles, gas mixtures, compressed air, flow phenomena, combustion, and available energy.

RADIO-FREQUENCY ELECTRICAL MEASUREMENTS. By H. A. Brown. Second edition New York, McGraw-Hill Book Company, 1938. 384 pages diagrams, charts, tables, 9 by 6 inches, cloth, $4.00. A guide for radio-engineering laboratory instruction. Within each chapter, covering a particular group of measurements of circuit constants, frequency, electron-tube coefficients, etc., the principles are explained, the laboratory equipment and procedure are described, and the precision attainable, the necessary precautions and the merits of the methods are discussed.

NATIONAL PHYSICAL LABORATORY REPORT for the YEAR 1937. London, His Majesty's Stationery Office, 1938, 150 pages, tables, 10 by 6 inches, paper, 2s. 6d. (obtainable from British Library of Information, 270 Madison Avenue, New York, N. Y. $0.80). Presents the reports of the naval laboratory and the departments of physics, electricity, radio, metrology, engineering, metallurgy, and aerodynamics, indicating the state of the current researches.

(A) MODERN SPANISH-ENGLISH and ENGLISH-SPANISH TECHNICAL and ENGINEERING DICTIONARY. By R. L. Guinle. New York, E. P. Dutton and Company, 1938. 311 pages, 10 by 6 inches, cloth, $4.00. There are relatively few dictionaries of Spanish and English technical terms. This is the work of an English engineer with long experience in South America. The vocabulary covers the terms used in civil, mechanical, and electrical engineering.

KORROSIONEN an EISEN und NICHTEISENMETALLEN. By A. Siegel. Berlin, J. Springer, 1938. 86 pages, illustrated, 11 by 8 inches, cloth, 21.60 rm.; paper, 19.50 rm. discusses the phenomenon of the pitting of iron and nonferrous metals, and is based upon experience in electric power plants and on ships.

ISAAC NEWTON, 1642–1727. By J. W. N. Sullivan, with a memoir of the author by C. Singer. New York, Macmillan Company, 1938. 275 pages, 9 by 6 inches, cloth, $2.50. A new biography in which the purpose has been to paint a clear picture of Newton, the man, stressing the events which influenced his career and throw light on his character. Discusses his scientific achievements particularly in their relation to the contemporary scene and subsequent developments.

ENGINEERING ELECTRONICS. By D. G. Fink. New York and London, McGraw-Hill Book Company, 1938. 358 pages, illustrated, 6 by 9 inches, leather, $3.50. A practical volume for engineers who wish to take up or review electronic principles and their application in typical engineering problems of tube use and circuit design. Covers the fundamentals of electron physics and electron tube structures, the engineering characteristics of a wide variety of tubes, and a demonstration of the application of tubes in a variety of electrical and industrial problems.

(The) J. & P. TRANSFORMER BOOK. By S. A. Stigant and H. M. Lacey. Seventh edition. London, Johnson & Phillips, Ltd., 1937. 916 pages, illustrated, 9 by 6 inches, cloth, 12s. 6d., plus 9d. postage in the British Isles or 12s. 6d. plus postage to any other destination. Previous item (*EE, June '38, p. 276*) erroneously quoted price of seventh edition at 6s. 6d.

Engineering Societies Library

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MAINTAINED as a public reference library of engineering and the allied sciences, this library is a co-operative activity of the national societies of civil, electrical, mechanical, and mining engineers.

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Papers Presented at Winter Convention, New York, N. Y., January 24–28, 1938

No.	Authors	Titles of Papers (Some Shortened)
☐ 37-91	Aiken & Birdsall	*Sharp Cut-Off in Vacuum Tubes, Slide-Back Voltmeter
☐ 37-100	Hardaway & Lewis	*Test and Operation of Petersen Coil on 100-Kv System
☐ 37-101	Woodruff	*Transmission-Line Transients in Motion Pictures
☐ 37-112	Sporn and Muller	*The Application and Performance of Carrier-Current Relaying
☐ 37-114	Kierstead	*Some Schemes of Current-Limiting Reactor Applications
☐ 37-115	McEachron & McMorris	*Discharge Currents in Distribution Arresters—Part II
☐ 37-121	Hirshfeld	*The PCC Street Car
☐ 37-122	Fitzgerald	*Results of Operation of PCC Cars in Pittsburgh
☐ 37-132	Evans & Monteith	*Recovery Voltage Characteristics of Transmission Systems
☐ 37-135	Coleman & Schirmer	*Protection Features for the Joint Use of Wood Poles
☐ 37-136	Montsinger	*Co-ordination of Power Transformers for Steep-Front Waves
☐ 37-137	Sporn & Lusignan	*Lightning Strength of Wood in Power-Transmission Structures
☐ 37-140	Richter	*An Electronic Arc-Length Monitor
☐ 37-141	Heitman	*The Rating of Resistance-Welding Transformers
☐ 37-154	Reed	*The Properties of Three-Phase Systems Deduced With Matrices
☐ 37-169	Vernam	*Printing Telegraph Operation of Way Wires
☐ 37-171	Kennedy & Hayward	*Harmonic-Current-Restrained Relays for Differential Protection
☐ 37-174	Schneider	*Thyratron Reactor Lighting Control

Papers Presented at North Eastern District Meeting, Lenox, Mass., May 18–20, 1938

☐ 38-40	McEachron	†Multiple Lightning Strokes—II
☐ 38-41	Lennox & DeBlieux	†A Direct-Current Transformer
☐ 38-42	LaPierre & Mansfield	†Photoelectric Weft-Straightener Control
☐ 38-44	Sporn & Gross	†Protector-Tube Application and Performance on 132-Kv Lines—II
☐ 38-45	Brosnan	†System Planning and Operation for Voltage Control
☐ 38-46	Benner & Lunge	†Voltage-Regulating-Equipment Characteristics
☐ 38-47	Landis	†Voltage Regulation and Control of Rural Lines
☐ 38-48	Burrell & Appleton	†The Periodic Voltage Survey as a Basis for Distribution Design
☐ 38-49	Rogers	†Regenerative Tension Control for Paper Winders
☐ 38-50	Bendz	†Comparison of Methods of Stopping Squirrel-Cage Induction Motors
☐ 38-51	Von Sothen	†The Application of Capacitors in Industrial Plants
☐ 38-52	Vogel	†Corona Voltages of Typical Transformer Insulation

Papers Presented at Summer Convention, Washington, D. C., June 20–24, 1938

☐ 37-58	Smith & Weygandt	*Double Line-to-Neutral Short Circuit of an Alternator
☐ 37-866	Appleman	*The Cause and Elimination of Noise in Small Motors
☐ 38-53	Calvert	Amplitudes of the MMF Harmonics for Fractional Slot Windings
☐ 38-54	Porter	Positive-Grid Characteristics of Triodes
☐ 38-55	Bewley	Traveling Waves Initiated by Switching
☐ 38-56	Subcomittee Report	Line-Type Lightning-Arrester Performance Data
☐ 38-57	Fonda	The Fundamental Principles of Fluorescence
☐ 38-58	Whitehead	Lightning Protection of 22-Kv Substations
☐ 38-59	Poritsky	Graphical Field-Plotting Methods in Engineering
☐ 38-60	Reagan	A Self-Checking System of Supervisory Control
☐ 38-61	Race	Tests on Oil-Impregnated Paper—III—Fluid Flow
☐ 38-62	Spurck & Strang	A New Multibreak Interrupter for Fast-Clearing Breakers
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